AL.2.1989-357
c.2

CANADIANA
SEP - 6 1989

AN EVALUATION OF PRESERVED WOOD FOUNDATIONS IN ALBERTA

Alberta
MUNICIPAL AFFAIRS
Innovative Housing Grants Program

Library and Archives Canada
Bibliothèque et Archives Canada

AN EVALUATION OF PRESERVED WOOD FOUNDATIONS IN ALBERTA

February 1989

Prepared by:

T. N. Brown, P. Eng.

The views and conclusions expressed and the recommendations made in this report are entirely those of the authors and should not be construed as expressing the opinions of Alberta Municipal Affairs.

With funding provided by
Alberta Municipal Affairs

ISBN: 0-88654-240-5

Digitized by the Internet Archive
in 2016

https://archive.org/details/evaluationofpres00brow_0

FOREWORD

The project documented in this report received funding under the Innovative Housing Grants Program of Alberta Municipal Affairs. The Innovative Housing Grants Program is intended to encourage and assist housing research and development which will reduce housing costs, improve the quality and performance of dwelling units and subdivisions, or increase the long term viability and competitiveness of Alberta's housing industry.

The Program offers assistance to builders, developers, consulting firms, professionals, industry groups, building products manufacturers, municipal governments, educational institutions, non-profit groups and individuals. At this time, priority areas for investigation include building design, construction technology, energy conservation, site and subdivision design, site servicing technology, residential building product development or improvement and information technology.

As the type of project and level of resources vary from applicant to applicant, the resulting documents are also varied. Comments and suggestions on this report are welcome. Please send comments or requests for further information to:

Innovative Housing Grants Program
Alberta Municipal Affairs
9925 - 107th Street
Edmonton, Alberta
T5K 2H9

Telephone: (403) 427-8150

TABLE OF CONTENTS

PAGE NO.

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 3

2.0 LITERATURE REVIEW & KEY ACTOR SURVEY 5

2.1 Literature Review 5

2.1.1 Methodology 5

2.1.2 Findings 5

2.1.3 Summary 7

2.2 Key Actor Survey 7

3.0 RESEARCH PROCEDURES 9

3.1 Interviews and Site Surveys 9

3.2 Soil Samples 11

3.2.1 Sampling Procedures 11

3.2.2 Findings 11

3.2.3 Conclusions & Recommendations 12

3.3 Wood Samples 13

3.3.1 Sampling Procedures 13

3.3.2 Findings 15

3.3.3 Conclusions & Recommendations 16

4.0 ECONOMIC ANALYSIS 17

5.0 CONCLUSION 19

LIST OF FIGURES

3.3.1 Wood Sampling Locations 14

APPENDICES

APPENDIX A - LITERATURE REVIEW AND KEY ACTOR SURVEY A1

PART I BIBLIOGRAPHY

Group I Research and Technical Publications...................... A2 - A4

Group II Innovative Design Publications.... A5

Group III General Product Information Publications...................... A6

Group IV Industry Design Standards Publications...................... A7

Group V Standards For Moisture Measurement Techniques........................ A8

Group VI Other Publications................ A9

PART II DATABASES SEARCHED........................... A10, A11

PART III DOCUMENT SAMPLES AND KEY ACTOR SURVEY....... A12 - A15

PART IV KEY ACTORS SURVEYED.......................... A16 - A20

APPENDIX B - INSPECTION RESULTS AND CHRONOLOGICAL ANALYSIS. B1

PART I A Summary of the Inspection Results......... B2 - B11

PART II A Summary of the Chronological Breakdown of the Test Houses........................... B12 - B13

APPENDIX C - OCCUPANT QUESTIONNAIRE........................ C1

PART I A Sample of the Questionnaire and a Summary of the Answers..................... C2 - C26

APPENDIX D - WOOD SAMPLES

PART I Moisture Profiles Perpendicular to the Grain.. D1 - D5

PART II Moisture Contents by Sampling Location...... D6 - D8

PART III Moisture Contents with Combined Negative and Positive Drainage....................... D9 - D20

PART IV Moisture Contents with Positive Backfill Drainage.................................. D21 - D32

PART V Moisture Contents with Negative Backfill Drainage.................................... D33 - D44

PART VI Moisture Contents at Specified Sampling Points.. D45 - D51

PART VII Mean Moisture Contents at Specified Sampling Points............................. D52 - D58

APPENDIX E - SOIL SAMPLES

PART I Moisture Content and Soil Classification Plots... E1 - E33

APPENDIX F - DESIGN STANDARDS, TESTING STANDARDS AND ENGINEERING CALCULATIONS...................... F1

PART I Design Standards............................. F2, F3

PART II Testing Standards........................... F4, F5

PART III Design Parameters Used for Engineering Calculations in this Report................. F6 - F10

PART IV Maximum Backfill Heights..................... F11, F12

PART V Combined Backfill Charts..................... F13 - F17

APPENDIX G - GLOSSARY OF TERMS.............................. G1, G2

EXECUTIVE SUMMARY

INTRODUCTION

Preserved wood foundations (PWF's) have been built in Canada for almost 30 years but have only been built in Alberta since the mid-seventies after the Building Standards Branch of Alberta Labour authorized PWF construction through the issuance of a StanData. This foundation system was later incorporated into the 1980 Alberta Building Code by way of a new StanData. By 1985 the system was fully integrated into the Code as articles 9.15.1.6 and 9.15.1.7. The articles set CAN3-S406-M83. "Construction of Preserved Wood Foundations" as the design and construction standards for PWF's in Alberta.

OBJECTIVES

While there has been considerable use of PWF's, there has been no systematic attempt to date to investigate, analyze and evaluate their performance. The purpose of this research project was to evaluate the performance of preserved wood foundations built in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate. The detailed objectives of the study were:

1. to carry out a review of published information and to survey key actors in the preserved wood foundation industry,

2. to carry out field investigations of the performance of preserved wood foundations, and

3. to analyze the data and recommend changes to existing preserved wood foundation standards and building codes, as appropriate.

METHODOLOGY

The data gathering phase of the project was divided into 5 tasks. These included:

1) computer search of 7 construction and forestry databases,
2) a literature review of 79 publications and papers,
3) a key actor survey involving 14 industry repesentatives,
4) site inspection and material sampling at 32 test homes, and
5) a questionnaire sent to 225 owners (128 respondents).

The 32 site inspections involved a detailed review of the residences and discussions with the owners plus the collection of soil samples and 25 wood samples from each PWF.

The soil and wood samples were collected and analyzed for moisture content by the investigator according to applicable testing standards.

KEY ISSUES & FINDINGS

The key issues raised in the study concerned the wood and soil moisture values as they were affected by prevailing construction practices and how they in turn affected the PWF basement. It was noted that the general construction quality was acceptable; however, there were major deficiencies in selection and placement of backfill materials and in surface water management. Despite these shortcomings, the average moisture level in the preserved wood walls was not only below the 30% level at which decay is initiated, but was also below 15%. The latter finding is significant because "wet service condition" design parameters must be used when wood's moisture content reaches 15%. Whereas these parameters are more restrictive than the conventional "dry-service condition" parameters, wet-service wood design adds to the cost of any PWF.

CONCLUSION

This study concluded that PWF basements perform exceptionally well despite the poor regime of water management found in the cases investigated. This implies that some of the design criteria and requirements may be unduly high. The study also concluded that where climatological and soil conditions are similar to those found in the test area, it may be possible to eliminate the use of preservative treated studs in favour of conventional lumber.

1.0 INTRODUCTION

Background

Preserved wood foundations (PWF's) have been built in Canada for almost 30 years but have only been built in Alberta since the mid-seventies after the Building Standards Branch of Alberta Labour authorized PWF construction through the issuance of a StanData. This foundation system was later incorporated into the 1980 Alberta Building Code by way of a new StanData. By 1985 the system was fully integrated into the Code as articles 9.15.1.6 and 9.15.1.7. The articles set CAN3-S406-M83. "Construction of Preserved Wood Foundations" as the design and construction standards for PWF's in Alberta.

Problem Definition and Study Purpose

While there has been considerable use of PWF's, there has been no systematic attempt to date to investigate, analyze and evaluate their performance. The purpose of this research project was to evaluate the performance of preserved wood foundations built in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate. The detailed objectives of the study were:

1. to carry out a review of published information and to survey key actors in the preserved wood foundation industry,

2. to carry out field investigations of the performance of preserved wood foundations, and

3. to analyze the data and recommend changes to existing preserved wood foundation standards and building codes, as appropriate.

The project investigated a sample of foundations which were built during the last 15 years when most PWF's in Alberta were built.

Study Approach

The researcher gathered information and data from a variety of sources. Contextual and historic data were obtained from an extensive review of data bases, monograms and publications dealing with PWF's. This information was augmented by a survey of 14 industry representatives. Investigation of existing PWF conditions at each of the 32 homes which were selected for study encompassed the following activities:

i) a visual inspection of the home and a survey of each owner's experiences and opinions (the survey procedure was augmented by the distribution of questionnaires to an additional 225 owners of PWF; 128 responded);

ii) the collection and laboratory analysis of a representative soil column at each site; and

iii) the laboratory analysis of 25 wood samples collected from each basement structure and foundation.

Based on an evaluation of the investigation findings, the researcher developed alternate construction scenarios and prepared comparative cost analysis.

Report Organization

The remainder of the report is divided into four parts:

Section 2.0 discusses the results of the literature review and survey of key industry actors.

Section 3.0 summarizes the research procedures in three sub-sections with respect to site visits and an owner questionnaire, soil sampling and analysis, and the sampling and and analysis of PWF wood samples. Each of these sub-sections discusses methodology, findings and conclusions.

Section 4.0 looks at the economic implications of alternative methods of construction and material options.

Section 5.0 contains conclusions.

The report also includes extensive technical Appendicies (A to G) which contain information on data sources, interview and questionnaire responses, results of wood and soil analysis, and testing and design standards for wood foundations.

2.0 LITERATURE REVIEW AND KEY ACTOR SURVEY

Introduction

In order to establish the current state of development of PWF's, the investigator conducted an extensive literative review of books and articles, and a survey of 14 of 22 key industry representatives contacted.

Findings from both the review and the survey suggested that PWF's are a viable building system whose proper execution and maintenance can result in an acceptable foundation and a superior interior environment. A summary of findings and comments from these two sources is provided below.

2.1 LITERATURE REVIEW

2.1.1 Methodology

Information was gathered on the basis of a search of seven construction, engineering and forestry databases. In addition, the author reviewed a total of 79 books, articles and monograms.

Findings have been grouped by subject matter. Individual books or papers are referenced where they are deemed significant. The reference code consists of a letter and number designating the relevant page in Appendix A followed by a number indicating the number of the reference on that page.

2.1.2 Findings

The literature discusses preservatives and wood performance, construction procedures and materials, and moisture within the home or building envelope.

Preservatives and Wood Performance

A 1985 report by L. I. Gaby (A2-8) describes the research and findings which arose from the construction of a test PWF in Athens, Georgia. While the test conditions vary from those to be found in a typical Canadian installation, the test was noteworthy for its generally positive findings which occurred in a hostile fungus and termite environment.

In the experiment, only part of the plywood foundation wall was covered with poly. This and the uncovered section were then monitored for moisture content weekly over a five-year period. The researchers made the following observations:

i) moisture content was seasonally cyclical; driest in winter, wettest in mid-summer;
ii) footing plates averaged 24% moisture content over the test period;
iii) 99% of the moisture readings taken from the basement ply below grade were less than 19%;
iv) 100% of the poly covered ply below grade exhibited moisture readings of 15% or less;
v) the moisture content of studs behind poly covered plywood averaged 10.8% over a range of 10.6% to 11.8%;
vi) studs behind plain plywood averaged a 12.6% moisture content; and
vii) on average, poly dampproofing lowered the wall moisture content readings 5% to 10%.

Construction Procedures and Materials

A number of reports including one by Scanada (A19) discussed and evaluated the rock drainage layer under PWF's. The concensus was that this was a very effective drainage technique and noted that the system could be installed in wet site conditions.

A comparison of prevailing American and Canadian standards indicates that in general, Canadian PWF's are built to higher and more demanding standards than those in the U.S.A. For example, in Canada stainless steel fasteners are required below grade, but these are not required in the United States. Where the U.S. permits the use of Grade I and occasionally Grade II soils in a 4" drainage pad, Canadian standards require a 5" pad of crushed rock. Finally, Canadian standards require more restrictive stress modification factors and base their design formulas on wet service conditions versus the American assumption of dry service conditions.

Moisture

The primary focus of PWF's will continue to be the exclusion of ground water from the basement. Those readers who wish to pursue this topic in greater detail might wish to read a book by R. A. Spray and F. A. Hedden (A3-25) entitled Field Observations of Moisture and Organism Damage in Insulated Houses. This thorough review of the issues covers both internal and external moisture sources, proper water management techniques, damage prevention and contains a section which describes warning indicators of impending moisture problems.

2.1.3 Summary

The literature was uniformly supportive of the PWF construction approach. The references noted that preservatives were effective in protecting wood from decay in even the most severe fungal and termite infested environments. Further, properly constructed wood basements were dry, warm and provided an excellent environment.

It was also noted that Canadian construction and material standards were higher than their American counterparts. While one must be careful about attempting a direct extrapolation of U.S. findings to Canadian situations, there is evidence to suggest that in some locations, it may be acceptable to use untreated lumber in wood foundations and to base design calculations on "dry service conditions".

2.2 Key Player Survey

Twenty-two industry representatives were invited to submit their views on specific issues with respect to PWF's. Fourteen of those contacted responded and, while there was considerable variation among those responses, there were also some common themes which merit discussion.

Preservatives

Two respondents raised points related to the use of wood preservatives. One suggested that the level of treatment be reviewed to determine whether lower levels of chemical penetration could be allowed as this would significantly lower the material cost of a PWF. Another was concerned about the toxicity of the chemicals used and suggested that those handling preserved wood should be advised to wear a mask and gloves.

Structure

Some respondents were concerned that the prevailing standard CAN3-S406-M83 should be more extensive and clear with respect to PWF structural requirements. Specifically, they wished to see information included on window framing and lintel design. It was noted that there had been PWF's failures in racking due to the differential pressures which result from uneven backfilling; consequently, it was suggested that the standard be expanded to include this topic. On the other hand, some concern was expressed that the existing standard was overly conservative. Particular reference was made to deletion of sleeper wood floors as a permitted design out of concern that some might fail. It was felt that the response should not have been deletion, but the development of a viable design and construction approach.

Finally, there was a call for the standard to recognize and adopt an approach to structural design which takes into account the contribution of all of the components of the system. In the existing standard the studs are designed to carry the full axial and laterial loads while the plywood is assumed to transfer only lateral loads to the studs. Composite design criteria would recognize the actual structural benefits which result from the composite/unified action of the plywood and studs working in concert to resist both axial and lateral loads.

Construction Practices

There were some minor remarks about ground water management. One questioned the correctness and effectiveness of current dampproofing methods. Another noted that he is successfully using weeping tiles as a drainage mechanism in PWF's.

The most critical concern addressed the improper application of the standard. In particular, contractors and designers often approve the use of improper backfill materials or procedures. Another respondent suggested that the current CSA standard CAN3-S406-M83 was being used as a construction handbook without proper consideration being given to how the specifications, conditions or underlying theory contained in that standard might apply to unique designs or site-specific problems.

3.0 RESEARCH PROCEDURES

The work encompassed site inspections, which included interviews with the owners; the collection and analysis of a typical soil sample of each home; and the collection and analysis of a variety of wood samples from various locations within each PWF basement that was studied.

The site investigations were based on a sample size which would provide a high level of confidence that findings would be representative of the universe of PWF's with respect to the key attribute, moisture content of the studs in PWF exterior walls. The total sample population was 2500 units. The chosen level of confidence was 99% and the acceptable deviation from the mean was set at 2%. It was assumed that the mean moisture content would be 15% and the range of samples would be 10% to 35%. These assumptions were in fact validated during the testing phase. Based on the above considerations, the required sample size was calculated to be 32 PWF's.

The research activities are discussed in the following sections. Each section in turn discusses the procedure, findings, and conclusions and recommendations related to that activity.

3.1 Site Inspection and Owner Interviews

The 32 owners who participated in the study were chosen from the files of the investigator's firm, Brown Engineering. The site visits and interviews were augmented by approximately 225 additional questionnaires which were sent to other owners of PWF's which had been also designed by Brown Engineering.

The 32 site reviews resulted in a diverse range of observations. However, there were a number of commonalities which merit discussion.

Nearly two thirds of the homeowners installed and maintained proper eavestroughs and downsponts as a means of surface water management, but nearly 60% of the lots were improperly graded and had sites which sloped toward the home. While it was impossible to inspect the exterior dampproofing because of landscaping, it was noted that despite the generally poor grading only three of the homes had experienced any form of basement leakage. In fact, the sump pumps in seven of the homes had never been active. This appears to suggest that with proper, well graded backfill and appropriate water management little or no water will reach the drainage layer and sump pump.

An inspection of the studdings showed them to be performing within design limits. The only exception was in a wall where the deflection was 70mm or 5/180. The studs involved did not bear any markings or grade stamp. The wall appears to have been constructed with American stud grade material. This lumber entered the Canadian market in the late seventies when domestic supplies could not meet the boom demand.

In walls where the displacement was within design norms, deflections of up to 1/180 were not considered aesthetically unpleasing. This observation was due to two factors. Firstly the maximum deflection is generally within 450mm of the floor and out of the main line of sight. More importantly, the deflection occurs during backfilling before the application of finishes and consequently, the drywall is applied and taped in a bowed configuration which results in a smooth finish with no cracks.

No galvanized framing anchors or straps showed any sign of deterioration, thus indicating that they were performing well. However, it was also noted that there had been a lapse in construction quality in some of the homes. Six of 32 homes did not have any insulation in the joist box spaces at the main floor. More importantly, 24 of 32 homes or 75% did not have an effective air/vapour barrier on the basement PWF walls.

Despite these various shortcomings, the 32 PWF's inspected were rated as being very good or excellent and were uniformly lauded by their owners. Most of the faults, such as poor eavestrough, could be readily corrected. Problems such as the poor grading and no air/vapour barrier might have been eliminated entirely with more stringent enforcement of the building code by local building inspectors.

The high positive evaluation from the site investigations and interviews was echoed in the broader survey of owners via the mailed questionnaire. A total of 128 out of 225 were returned for a response rate of 57% which is considered excellent for this type of survey. The survey is summarized in Appendix C for those who wish to undertake a detailed analysis. Readers interested in measures of satisfaction are directed to questions 8, 11, 13, 28, 33, 70 and 73. PWF performance is rated in questions 12, 33, 60 - 62 and 70 - 73. Care of construction was covered in questions 10 and 67b; questions 68 and 69 address insurance and resale value.

In summary, one could make the following generalities:

i) occupants of properly constructed PWF's are satisfied with their homes;
ii) properly constructed PWF's perform very well and provide dry, warm and comfortable living space;
iii) PWF's are perceived as easy to build;
iv) PWF's don't result in any insurance surcharge, and
v) owners of PWF's consider them equal to or better than other types of basement construction with which they have experience.

3.2 SOIL SAMPLES

3.2.1 Sampling Procedures

Soil samples were obtained at each of the 32 inspected homes. The samples were taken at a distance of 900mm from the basement wall and obtained using a 50mm hand auger. The test holes were driven below the footing plate and drainage layer in order to obtain a representative sample of the underlying soil. Upon removal, samples were vacuum sealed in poly bags and marked for identification before being returned to the laboratory for testing.

Moisture content of the soil samples was determined in accordance with standard ASTM D 2216-80 "Standard Method for Laboratory Determination of Water (Moisture) Content of Soils, Rock and Soil Aggregate Mixtures". The resulting findings were plotted on the moisture -vs- location graphs located in Appendix E. In addition to moisture content, each plot was identified for its typical drainage pattern; negative, positive or neutral.

The soil samples were analyzed for type and classified in conformance with the "Unified Soils Classification System". This information is also noted on Appendix E plots.

3.2.2 Findings

There were two significant observations. As noted on plot E9, when topsoil and organics are mixed with the granular backfill, there is a significant increase in normal moisture content, in this instance, from 8% to 22%. In instances where the native soil/sands exhibit high permeability, such as E9 and E17, the resulting moisture levels are very low being 5% and 8% at 360mm and 900mm below the footings respectively.

It was also noted that only in the case of basement E9 was the backfill installed as specified, that is, free draining granular backfill below 450mm of an impermeable topsoil cap.

Yet, despite this rather significant shortcoming in construction, the soils appeared to exhibit generally acceptable moisture profiles. It was calculated that some walls were carrying backfill pressures up to three times as high as the limits specified in CAN3-S406-M83.

3.2.3 Conclusion & Recommendations

In light of the findings, it is suggested that where the native soil exhibits a sufficiently high permeability, it is not necessary to install a 6" granular drainage layer below the PWF construction. Further, it is noted that most basements have exhibited adequate ground moisture control without the mandated drainage layer; consequently, it is recommended that a combined backfill of stiff to medium clay over a granular material would be acceptable. There are however two caveats; (i) the combined backfill must not result in forces which exceed allowable stress and deflection limits in the studs and plywood and (ii) the equivalent fluid pressures used for the clay in the design calculations must equal 75pcf, which places limitations on the type of clay that can be used.

Finally, it is noted that only 3% of the basements had been backfilled or graded in conformance with prevailing code requirements; consequently, it is recommended that the building code be clarified to emphasize that the authority having jurisdiction is responsible for the inspection and approval of these construction practices.

3.3 WOOD SAMPLES

3.3.1 Sampling Procedures

Approximately 25 wood samples were taken from different locations in the foundations of each of the inspected homes as noted on Figure 3.3.1, page 14. These were subsequently tested in the laboratory to ascertain their moisture content.

One sample was taken from each of the following locations:

i) PWF bottom plate (It was not possible to secure samples from the footing plates),
ii) top plate,
iii) tie plate,
iv) bottom plate of an interior partition, and
v) 75mm above bottom plate in interior partition.

Two samples were taken from a main floor joist. Samples of the outer, middle and inner thirds of the studding were taken from each of the following six locations in the selected PWF stud at each house:

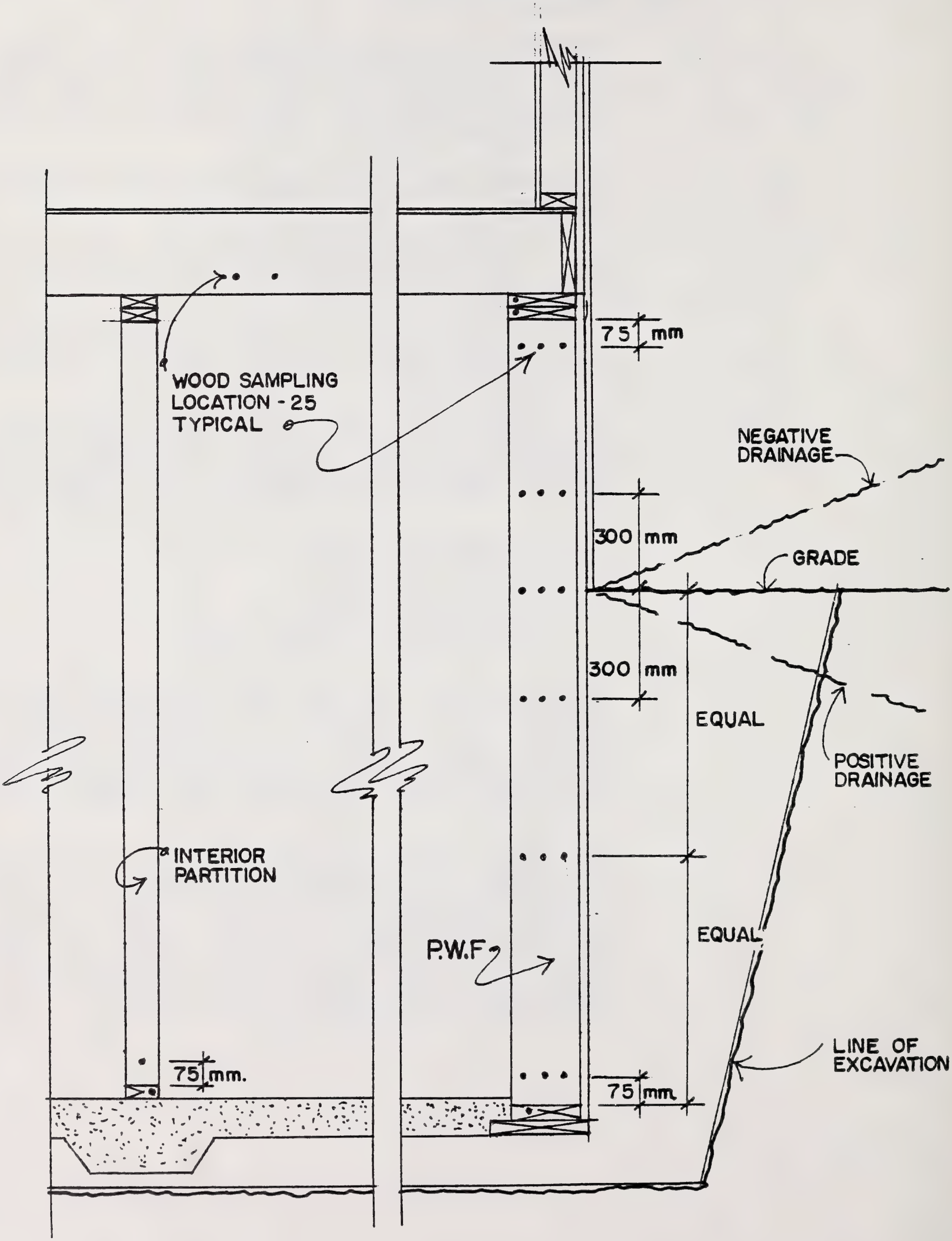
i) 75mm below the top plate,
ii) 300mm above grade,
iii) level with grade,
iv) 300mm below grade,
v) at mid-point of backfill, and
vi) 75mm above the bottom plate.

Samples were not obtained from the exterior plywood sheathing of the basements as all sampled homeowners were unwilling to have any punctures made in their primary moisture barrier. However electronic moisture meter readings were made of the PWF plywood at each location where wood samples were taken.

The samples, taken during the last week of July and August 1987, were collected in accordance with the recognized standard ASTM D 2016-74 (Reapproved 1984) "Standard Test Methods for Moisture Content of Wood". Wood samples were obtained using a powered 1/2" plug cutter. After extraction, the cores were placed in a poly bag, vacuum sealed, and identified before transportation to the laboratory for testing.

FIGURE 3.3.1

WOOD SAMPLING LOCATIONS



The moisture content of the samples were also determined in accordance with standard ASTM D 2016-74. The procedure involved the precise weighing of the wood samples before and after heating in an oven. The weight differential is assumed to be due to the loss of moisture and is expressed as a percentage of the wood's dry weight. All of the moisture content readings were used in the data analysis.

3.3.2 Findings

The moisture readings were plotted on a variety of moisture-vs-location graphs. These graphs are to be found in Appendix D, pages D1 to D58. The graphs on pages D2 and D3 illustrates the moisture profiles across the face of the studs for the positive, negative and combined drainage. Page D7 provides an analysis of the vertifical moisture profiles in the studs. Pages D10 to D58 inclusive present detailed plots and distribution curves of the moisture content readings for the full range of wood samples.

The analysis of the samples produced the following key findings:

i) Moisture contents were always highest when the site sloped towards the house i.e. negative drainage.
ii) The studs had higher moisture content towards their outside face.
iii) No stud exhibited a moisture content above 30% which is generally accepted as the point at which rot can occur.
iv) Base plates exhibited moisture levels above 30%.
v) Moisture content of studs decreases with distance above the base plate.
vi) Even under adverse negative drainage conditions, the mean, stud moisture contents did not exceed 15% at any points other than the point 3" above the base plate.

3.3.3 Conclusions and Recommendations

A test of the assumptions noted in Section 3.0 on methodology indicates that the study findings are accurate to 2% at a 99% level of confidence. Based on the findings one can make the follow recommendations.

1) Because no moisture contents exceeded 30% or even 15% above 3" over the plate, PWF studs in climatic and soil conditions similar to the test area need not be treated with preservative.

2) Dry service conditions can be used in calculating structural performance as studs only exhibit high (15%+) readings in the lower 3".

3) The inclusion of a dampproofing material between the base plate and the studs would eliminate the wicking effect from the moist plate into the essentially dry stud.

4.0 ECONOMIC ANALYSIS

The study included an economic analysis of the impact which proposed changes might have on the cost of a PWF for the typical single family home. The analysis was based on a hypothetical foundation which was 32' X 40' and had an 8' high wall. It was assumed that the excavation extended 2' beyond the base of the wall and sloped outwards to 3' beyond the wall at the top of the excavation. The analysis was based on Edmonton retail prices as of September 1987. The analysis encompassed four areas of interest: untreated lumber, dry service design conditions, backfill options and material substitutions.

Savings with Untreated Lumber

The field investigation and laboratory tests suggested that it was possible to build parts of PWF's with untreated lumber in certain situations (Section 3.3.3). When compared to the cost of treated dimensional stock found in the average PWF, it was found that use of untreated 2 X 6 @ 16" o.c. #2 SPF would save an average of $269.00 in our hypothetical example. When the sheathing is installed horizontally, the saving on untreated blocking material adds another $30.00 to that amount.

Savings from Designing for "Dry Service" Condition

As previously noted, the low moisture content not only inhibits decay, but also allows the designer to base his structural design on "dry service" wood performance. When allowances are made for this improved performance, it was found that when dealing with the average backfill height of 6'-1", one can use 2 X 6 @ 16" on centre rather than 2 X 6 @ 12" on centre. This reduction in lumber permits a saving of $230 on the foundation.

Savings from Using Existing Soils (rather than replacing them with sand)

Because of the very wide variety of soil conditions and backfill heights, it was necessary to develop a variety of scenarios for consideration. Based on the field work and soil analysis, it was considered appropriate to analyze three combinations of backfill. In the analysis, an allowance was provided for savings from the non-disposal of excess clay, and the sand backfill was considered as having a 1' clay cap. It was assumed that the clay came from the PWF excavation.

Case #I - Backfill Height 4'-6"

In this typical bi-level arrangement, the 2 X 6 stud spacing decreases from 16" o/c to 12" o/c and the corresponding figures are plus $140 for lumber minus $607 on material for a net saving of $467.

Case #II - Backfill Height 5'-0"

With a sand backfill, one requires a 2 x 6 @ 16" #2 SPF stud wall. With 5' of clay, the wall must be upgraded to 2 x 8 @ 16" #2 SPF. While this increases the lumber costs by $177, one saves $703 on backfill and haulage costs for a net gain of $526.

Case #III - Backfill Height 6'-0"

Using the logic outlined in Case I, lumber increases from 2 X 6 @ 16" to 2 X 8 @ 12". Wood costs rise by $887 for a net saving of $511.

Savings from Material Substitution

Finally, the study considered the economic implications of making substitutions in some of the conventional materials used in PWF's. The two areas which lent themselves to the greatest potential benefit were the footing and drainage layer.

Traditionally market forces have shown that while owners will accept a wood foundation, they have insisted on retaining a concrete footing. The analysis showed that the difference in cost between a 2 X 8 PWF footing, $104, and an 8 X 18 concrete footing, $404, is $300.

As shown in the soil analysis and documented in the sample profiles, it is possible to eliminate the rock or gravel drainage layer where the undisturbed native soils exhibit sufficient porosity. It was calculated that the 6" drainage layer costs upwards of $414.

Cumulative Savings

It would appear that careful material selection and the use of site specific design standards can result in significant savings. A summary of these savings is provided below:

i)	Untreated Lumber	$ 269.00
	- Untreated Blocking	30.00
ii)	Dry Service Conditions	230.00
iii)	Existing Soil Backfill (average)	500.00
iv)	Material Substitution	300.00
	Average Anticipated Savings	$ 1,329.00
v)	Delete drainage layer	414.00
	Optimum Savings	$ 1,743.00

In light of the significant potential savings which can result from careful design and material selection, these options merit serious consideration.

5.0 CONCLUSION

The foregoing economic appraisal and an analysis of the research findings, suggest a reconsideration and re-evaluation of PWF standards.

The findings generally indicate extremely low moisture content in the studs despite the poor water and drainage management actions taken at the homes that were investigated. These findings suggest that designers take a more site-specific approach to their design and calculation of PWF's to achieve a more rational and cost-effective design. Furthermore, there is considerable evidence in the economic analysis to suggest that the potential savings will not only pay for the additional design services but will also return a significant financial benefit to the owner.

While these findings and recommendations are currently limited in application to those areas with soil and climatic conditions similar to the Edmonton area, the conclusions reached in this report should be seriously considered for their potential impact on all PWF installations.

Appendix A - Literature Review and Key Actor Survey

Part 1 - Bibliography

The published and non-published information that was obtained and reviewed is listed on pages A2 to A9.

BIBLIOGRAPHY

Published and Non-Published Information Obtained and Reviewed

GROUP I Research and Technical Publications

1. American Wood-Preservers' Association, Report of Committee P-4, Water-Borne Systems.

2. Bendtsen, B.A. and W.E. Eslyn, 1968. House Foundation of Treated Wood After 30 Years' Service.

3. Camarano, A.M., All-Weather Pressure Treated Wood Foundation.

4. Dodge, Robert J., 1957. Prolonging Life of Wood in Houses.

5. Doyle, Edward E., 1983. An Investigation of the Biomethylation of Arsenic in Preserved Wood Foundations.

6. Eslyn, Wallace E. Impact of Biodeterioration on Structural Use of Wood - Research Needs.

7. Forintek Canada Corp., 1981. The Use and Misuse of Wood in Construction and Architectural Design.

8. Gaby, L.I., 1985. Moisture Content in a Wood Foundation Wall.

9. Gjovik, L.R. and R.H. Baechler, 1970. Treated Wood Foundations for Buildings.

10. Hurst, Homer T., Economical Underground House Structures.

11. Koenigshof, G.A., 1970. Design and Construction of Pressure-Treated Wood Residential Foundation Walls.

12. Link, F.A., 1976. Stainless Steel Fasteners, Pneumatic Tools Recommended for Wood Foundations.

13. Moore, Wendell, 1975. All Weather Wood Foundation - An Update.

14. Pahlstrom, G.B., 1982. Durability of CCA-B Treated Plywood Having Nonconforming Penetration Patterns.

15. Percival, Donald H., 1975. Experiences With a Wood Foundation.

16. Pile, K.C., 1984. Study of House Foundations at Elizabeth East, South Australia.

17. Rose, J.D., 1977. Racking Performance of Wood-Foundation Shear Walls Assembled with Stainless-Steel Fasteners.

18. Rose, John D., 1977. Wood Foundation Shear Walls.

19. Scanada Consultants Limited, Field Performance of Gravel Pad Drainage Installations Under Basements.

20. Sedziak, H.P. et. al, Performance of Preserved Wood Foundations and Exterior Cladding Systems in Experimental Houses.

21. Sedziak, H.P. and H.H. Unligil, 1976. The Use of Preserved Wood Foundations in Residential Housing.

22. Shields, J.K., 1977. The Condition of Preserved Wooden Foundations in Two Experimental Houses.

23. Shields, J.K., J. Krzyzewski and H.P. Sedziak, 1974. Performance of Preserved Wood Foundations and Exterior Cladding Systems in Experimental Houses.

24. Spelter, H., 1983. Comparing In-Place Costs of Wood and Masonry Foundations.

25. Spray, Richard A. and Frank A. Hedden, 1983. Field Observations of Moisture and Organism Damage in Insulated Houses.

26. Vick, C.B., 1980. Structural Bonding of CCA (Chromated Copper Arsenate) - Treated Wood Foundations.

27. Vick, Charles B., 1980. Structural Bonding of CCA-Treated Wood Foundation systems.

28. Vick, C.B.,
1981. Adhesive-Bonded Shear Walls for CCA-Treated Wood Foundations.

29. Vick, C.B.,
1981. Structural Bonding of CCA-Treated Wood Foundations.

GROUP II Innovative Design Publications

1. Anonymous,
   1977. Standard Wood Foundation Panels Telescope to Fit Any Wall Length.

2. Bond, T.E. and J.O. Newman,
   1978. Panelized Wood Foundations for Conventional and Underground Houses.

3. Godbey, Luther C. and Jerry O. Newman,
   1975. Standardized Panel Foundation System for Modular, Stick Built, and/or Mobile Homes.

4. Stern, George E.,
   1969. Novel Wood Foundation-Framing System.

5. Stern, E.G.,
   1969. An Integrated Wood Foundation-Framing System.

6. Vick, C.B.,
   1984. Adhesives for Wood. Research, Applications and Needs. R.H. Gillespie (editor).

GROUP III General Product Information Publications

1. American Plywood Association,
1978. All-Weather Wood Foundation Systems. Rev.

2. American Plywood Association,
1978. All-Weather Wood Foundation: A Builder's Checklist. Rev.

3. Anonymous,
1980. U.S. Systems Success Key Is Foam-Core Sandwich Panels.

4. Anonymous,
1976. Wood Foundation's Big Benefit: Doubles the House Area at No Increase in Cost.

5. Anonymous,
1976. Warm, Dry Wood Basements.

6. Anonymous,
1973. Treated Wood Foundations for Houses.

7. Anonymous,
1973. Technical Study of Glued Plywood Floors and Timber Foundation.

8. Camarano, A.M.,
1980. Marketing Impact of the All-Weather Wood Foundation on Forest Products Industries.

9. Canadian Institute of Timber Construction,
1987. Preserved Wood Foundation.

10. Cornick, Dean,
1978. How Bad are Wood Basements? Pekin, III. Producer Can Tell You.

11. Dost, W.A.,
1977. All-Weather Wood Foundation - A Truly New Market for Wood.

12. Eliades, George K.,
1975. All-Weather Wood Foundation: Innovation in Design.

13. Spelter, H.N. and L.R. Gjovik,
1984. The Cost of Wood vs Masonry.

14. Tayelor, F.A.,
1981. Architectural Opportunities Seminar - Use and Misuses of Wood in Construction and Architectural Design.

GROUP IV Industry Design Standards Publications

1. American Plywood Association,
   1978. All-Weather Wood Foundation System. Rev.

2. American Plywood Association,
   The All-Weather Wood Foundation: Why, What and How.

3. Canadian Standards Association, Standards Council of Canada,
   1983. Construction of Preserved Wood Foundations.

4. Canadian Wood Council,
   1981. Construction Guide for Preserved Wood Foundations. Rev. Ed. with supplements No. 1 and 2.

5. National Forest Products Association,
   1982. All-Weather Wood Foundation System: Design, Fabrication, Installation: Manual. Rev.

6. National Forest Products Association,
   1975. All-Weather Wood Foundation System: Design, Fabrication, Installation: Manual. Rev.

7. National Forest Products Association,
   The All-Weather Wood Foundation System. Basic Requirements.

8. University of Illinois at Urgana-Champaign.
   1974. An All-Weather Wood Foundation for a Crawl-Space House.

9. University of illinois at Urbana-champaign,
   1974. An All-Weather Wood Foundation for a Basement House.

GROUP V Standards for Moisture Measurement Techniques

1. ASTM D 1037 - 78 Standard methods of Evaluating the Properties of Wood Base Fibre and Particle Panel Materials.

2. ASTM D 2216 - 80 Standard method for Laboratory Determination of Water (Moisture) Content of the Soil, Rock and Soil-Aggregate Mixtures.

3. ASTM D 3017 - 78 Standard test method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

4. ASTM D 1860 - 63 (Reapproved 1981) Standard test method for Moisture and Creosote Type Preservative in Wood.

5. ASTM D 2016 - 74 (Reapproved 1981) Standard test method for Moisture and Creosote Type Preservative in Wood.

6. ASTM D 143 - 52 (Reapproved 1978) Standard methods of testing Small Clear Speciments of Wood.

7. Forintek Canada Corporation. Project No. FCC-43-10-014.
CFS No: 7.
Measurement of Moisture content in Preserved Wood Foundation Lumber and Plywood Using Electrical-Resistance-Based Instrumentation.

GROUP VI Other Publications

1. Applefield, M., 1970. Building code Relationships to Wood Use for Floor-Foundation Systems of Single-Family Houses.

2. Bergman, G., 1977. Kontrollerad bevattnins-ett forsok att radda hotad trapaolgrundlaggning. (Controlled Watering: An Attempt to Save Threatened Timber Foundation.)

3. Cameron, D.A. and P.F. Walsh, 1979. Experimental Investigation Into Timber Piles for Residential Foundation in Expansive Clays.

4. Cole, James T., Thomas S. Zawacki and Robert H. Elkins, et. al, 1980. Application of a Generalized Model of Air Infiltration to Existiing Homes.

5. Eberhard, J.P., et. al, 1977. Energy Efficiency in Wood Building Construction.

6. Ghaly, A.E., 1983. Innovative Construction for Anti-Termite Production.

7. Judd, J., 1983. FPL's Truss-Framed System Offers High Quality Housing at Affordable Prices.

8. Levin, E., 1967. Element Design Guide for Timber Structures.

9. Nova Scotia Research Foundation Corporation, 1979. The Wood Book: The Homeowner's Wood Burning Manual or Answers to Your Burning Questions. Prepared for the Nova Scotia Department of Mines and Energy by the Nova Scotia Research Foundation Corporation.

10. Prettie, R.J., 1957. New Applications for Preservative Treated Wood.

11. R.M.E. Diamant Archit., 1965. The Dorran System (of industrialized building).

12. Smith, R.S., 1978. Protection of Plywood Under Adverse Environments From Biodeterioration by Fungi.

13. Youngberg, Robert J., 1982. Membrane-Lined Foundation Systems for Liquid Thermal Storage.

14. Zaremba, J., 1959. Wood Versus Concrete in House Foundations.

Appendix A Literature Review and Key Actor Survey.

Part II Databases Searched

This Part II contains the list of databases that were searched by the Alberta Research Council and the National Research Council.

Appendix A Databases Searched for Literature Review.

1.	FOREST	(Forest Products).
2.	BRIX	(Building and Construction).
3.	PICA	(Construction and Architecture).
4.	EI	(Engineering Information).
5.	EIM	(Engineering Information - Meetings).
6.	NTIS	(U.S. National Technical Information Services - Government Reports).
7.	OON	(National Research Council, Canada-in house Publications).

Appendix A Literature Review and Key Actor Survey.

Part III Samples Documents for Key Actor Survey

This Part III contains a sample of the documents sent to persons contacted during the key Actor Survey.

Brown Engineering
Consulting Engineers

#234, 9738 - 51 Avenue
Edmonton, Alberta
T6E 0A6

Telephone (404) 437-4702

September 17, 1987

Hello

My name is Terry Brown and I am the principal of Brown Engineering an Edmonton based Consulting Engineering firm. We have specialized in the design of Preserved Wood Foundations over the past 12 years and to date we have designed PWF's for over 3000 residential housing units and a number of commercial projects.

We are presently commencing a very detailed research project into the performance of PFW's that have been installed over the past 15 years. Attached is a photo copy of part of the Terms of Reference for this study. By way of this letter we are requesting any additions to the scope of the project that you may feel would be beneficial in assessing the total performance of the PWF system.

We are also requesting that if you have any questions regarding the contents of CAN 3 S 406 M 83 Construction of Preserved Wood Foundations that you also forward these to us.

If you should have any technical reports on the performance of PFW's we would appreciate a copy of them or the source where we may obtain a copy.

We are working on a tight schedule and therefore request that you forward any input to us within 14 days of receiving this letter, a self addressed envelope for this purpose is enclosed or if you so desire you may phone me collect at (403) 437-4702.

Thank you for your co-operation.

Yours truly,

Terry N. Brown, P.Eng.

SCHEDULE A

TERMS OF REFERENCE

PRESERVED WOOD FOUNDATION STUDY

A. INTRODUCTION

Although preserved wood basements have been in use for almost thirty years, it was not until the late seventies that they started to be built in considerable numbers in Alberta. The current standard for preserved wood foundations (PWF), CAN 3-S406-M83 (enacted in 1984) was the first of its kind and is based on very conservative engineering practice. Furthermore, there is little empirical information available on their performance. This project, which is jointly funded by the Alberta Departments of Municipal Affairs - Housing and Forestry, Lands and Wildlife responds to the need to assess the performance and to suggest more cost-effective standards.

B. OBJECTIVES

The purpose of this research project is to carry out extensive field investigations on the performance of preserved wood foundations built over the last 15 years in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate.

The detailed objectives of this research project are as follows:

1. To carry out a review of published information and to survey key actors in the preserved wood foundation industry to identify key issues.
2. To carry out field investigations to determine the performance of preserved wood foundations.
3. To analyze the data and recommend changes to existing preserved wood foundation standards and building codes.
4. To prepare a final report summarizing this research project.
5. Present the findings of the study to appropriate standard writing committees if authorized by both funding Departments.

C. SCOPE

The scope of this research project is as follows:

1. To carry out a review of published information on preserved wood foundations, basement waterproofing and basement drainage systems.

2. To survey key actors in the preserved wood foundation industry to determine if any additional research should be carried out during the field investigations of existing preserved wood foundations.

3. To carry out field investigation on existing preserved wood basements to determine the following:

   i) the moisture content of preserved wood foundations with treated as well as untreated studs and backfill;
   ii) deterioration of treated and untreated wall studs, plates and sheathing;
   iii) the deflection of wall studs;
   iv) the conditions of various types of fasteners applied to the preserved wood foundations; and
   v) the qualitative performance of the basement wall waterproofing and drainage system.

4. To analyze the data generated by the field investigations and laboratory tests and compare them with findings of the literature review and recommend changes to CAN 3-S406-M83, Alberta Building Code and other related standards and codes.

5. To prepare interim reports and a final report summarizing the work in accordance with Schedule 'B'.

6. To disseminate, in accordance with article 10 of the Letter of Agreement, the findings of the study to the recently re-established CSA committee on preserved wood foundations, the Associate Committee on the National Building Code, and other appropriate standard writing committees and organizations.

D. FOCUS

The study shall focus on the field investigation of the performance of preserved wood foundations built between 1970 and 1985 and the analysis of the field data leading to recommendations for changes of existing preserved wood standards and codes.

E. APPROACH

The work shall be divided into the following phases and include the tasks set out below.

Appendix A Literature Review and Key Actor Survey

Part IV Key Actors Surveyed

This Part IV contains the names of the persons and firms that were contacted during the Key Actor Survey portion of this study.

PERSONAL CONTACTS

	Name	Response	Type of response 1. Telephone 2. Written 3. Meeting
1.	Mr. T. Bearden, P.Eng. Bearden Engineering Consultants Ltd. 250 4919 - 59 Street Red Deer, Alberta Canada T4N 2N1	Yes	1
2.	Mr. G.E. Brudermann Domtar Chemicals Group Wood Preserving Division 104 Doyon Avenue Pointe Claire, Quebec Phone: (514) 694-2162	No	
3.	Mr. Colin Campbell, P.Eng. Campbell, Woodall & Associates Ltd. 250 1210 - 8 Street S.W. Calgary, Alberta Canada T2R 1L3 Phone: 228-3178	Yes	2
4.	Mr. B. Davison, P.Eng. B. Davison Consulting Engineer Ltd. 8107 - 143 Street Edmonton, Alberta Canada T5R 0N9	Yes	1
5.	Mr. Fred Dumont National Research Council 110 Gymnasium Road Saskatoon, Sask. Canada S7K 5T6	Yes	1

PERSONAL CONTACTS

Name Response Type of response
1. Telephone
2. Written
3. Meeting

6. Mr. Bruce Fulford Yes 2

Koppers-Hickson Canada Ltd
2233 Argentina road
Suite 303
Mississuaga, Ontario
Canada M5N 2X7

Phone: 1-800-387-8349

7. Mr. Gary Gibson, P.Eng. No
Sure West Consulting Services
P.O. Box 5019
Ded Deer, Alberta
Canada T4N 6A1

8. Mr. Bill Glover Yes 3

Canadian Standards Association
178 Rexdale Blvd.
Rexdale, Ontario
Canada M9W 1R3

9. Mr. K. Hanson No

Victory Homes
#110 - 2103 Airport Drive
Saskatoon, Sask.
Canada S7L 6W2

10. Mr. M.S. Hollick, President/Manager Yes 1

Exterior Wood Limited
9697 - 190 Street
Surrey, British Columbia
V3T 4W2

11. Mr. Eric Jones Yes 1

Canadian Wood Council
85 Albert Street
Ottawa, Ontario
Canada K2P 0M8

PERSONAL CONTACTS

	Name	Response	Type of response 1. Telephone 2. Written 3. Meeting
12.	Mr. L.J. Lappi, P.Eng. Canada Mortgage and Housing Suite 300 410 - 22 Street East Saskatoon, Sask. Canada S7K 5T6	Yes	2
13.	Mr. R.N. Massiah, P.Eng. Alberta Dept. of Labour 707, 10808 - 99 Avenue Edmonton, Alberta Canada T5K 0G5	Yes	2
14.	Mr. Dave Milton Canadian Institute of Treated Wood #506 75 Albert Street Ottawa, Ontario Canada K1P 5E7	Yes	1
15.	Mr. W.M. McCance, P.Eng. The Waterboard Association 75 The Donway W. Suite 400 Don Mills, Ontario Canada M3C 2E9 Phone: (604) 278-0963	No	
16.	Mr. Tom McGill and Mr. Tom Morayto Timber Specialties 6521 Mississuaga Road Mississuaga, Ontario Canada L5N 1A6	No	
17.	Mr. R.H.B. McLaughlin, P.Eng. University of New Brunswick P.O. Box 4400 Fredericton, New Brunswick Canada B3H E3B	No	

PERSONAL CONTACTS

Name Response Type of response
1. Telephone
2. Written
3. Meeting

18. Mr. H.A. Nagac, P.Eng. No

Ace Engineering Ltd.
1380 Commercial Way
Penticton, British Columbia
Canada V2A 3H6

Phone: (604) 493-7211

19. Mr. P.E. Rivers, P.Eng. Yes 1

Rivers P E Associates Ltd.
106 10510 - 121 Street
Edmonton, Alberta
Canada T5N 1L4

20. Mr. M. Rossiker, P.Eng. Yes 1

Mid Canada Consulting Group Ltd.
17 Rowland Crescent
St. Albert, Alberta
Canada T8N 3X4

Phone: 458-0078

21. Mr. D.L. Scott No

National Research Council of Canada
Atlantic Regional Station
Div. of Building Research
1411 Oxford Street
Halifax, Nova Scotia
Canada B3H 3Z1

Phone: (902) 428-8255

22. Mr. Jerry Van-Rajn Yes 2

Forentec Canada Corporation
800 Montreal Road
Ottawa, Ontario
Canada K1G 3Z5

Appendix B Inspection and Sampling.

The results of the inspections and a table showing the year of construction are contained in this Appendix.

Appendix B Inspection and Sampling.

Part I A Summary of the Inspection Results.

The summary of the inspection results is contained in pages B2 to B8. Additional inspection information is summarized on pages B10 and B11.

INSPECTIONS

1.0 EXTERIOR DRAINAGE OF GROUP

.1	Positive.	14
.2	Negative with Sod.	12
.3	Negative without Sod.	7

Total Number of samples = 33

2.0 EAVESTROUGH

.1	Eavestrough with downspouts draining water away from the building.	20
.2	Eavestrough with no drainage away from the building.	9
.3	No Eavestrough.	4

Total Number of samples = 33

3.0 INTERIOR LEAKAGE AND FLOODING

.1	Water leaking into foundation through exterior wall.	3
.2	Water leaking into foundation through the floor.	1
.3	No leakage.	28

Total Number of samples = 32

4.0 TYPE OF FOOTING

.1	Wood	19
.2	Concrete on soil	5
.3	Concrete on gravel	1
.4	Concrete on soil with drain pipes	2
.5	Unable to Identify	5

Total Number of samples = 32

5.0 BASEMENT FLOOR

.10 TYPE

.1	Concrete	19
.2	Suspended	4
.3	Wood Sleeper	9

Total Number of samples = 32

.20 DIFFERENTIAL ELEVATION OF FLOOR

.1	Very little	2
.2	1/2" - 1"	2
.3	To small to measure	28

Total Number of samples = 32

.30 CONCRETE FLOOR CRACKING

.1	No cracking	9
.2	Small cracks	8
.3	1/8" - 1/4" cracks	1
.4	1/4" plus cracks	0
.5	Unable to determine	1

Total Number of samples = 19

6.0 TYPE OF WALL

.10 PLYWOOD

.1	1/2" perpendicular	18
.2	1/2" parallel	4
.3	5/8" perpendicular	3
.4	5/8" parallel	0
.5	Unable to Identify	7

Total Number of samples = 32

.20 STUD SIZE AND SPACING

.1	2x6	27
.2	2x8	8
.3	2x10	0
.4	12" on centre	4
.5	16" on centre	31
.6	Other	0

Total Number of samples = 35

.30 STUD GRADE

.1	Select structural	0
.2	No. 1	8
.3	No. 2	19
.4	Unable to identify	9

Total Number of samples = 36

.40 STUD SPECIES

.1	D. FIR	0
.2	H. FIR	7
.3	S-P-F	5
.4	L. PINE	9
.5	J. PINE	5
.6	Unable to identify	9

Total Number of samples = 35

.50 DEFLECTIONS IN THE STUDS

.1	0	16
.2	0 - 1/4"	10
.3	1/4" - 1/2"	7

.4 Other See page B10 for breakdown of other deflections.

Total Number of samples = 35

.60 CHEMICAL TREATMENT

.1	CCA	32
.2	ACA	0
.3	Unable to determine	0

Total Number of samples = 32

.70 DAMPROOFING

.1	6 Mil Poly	6
.2	Bituminous Dampproofing	11
.3	6 Mil Poly and Bituminous Dampproofing	3
.4	Unable to determine	12

Total Number of samples = 32

.80 INTERIOR CONDENSATION

.1	No Condensation	32
.2	Condensation	0

Total Number of samples = 32

.90 WALL HEIGHT

.1	0 ft - 4 ft	0
.2	4 ft - 7 ft	0
.3	7 ft - 8 ft	34
.4	8 ft - 9 ft	0
.5	9 ft - 10 ft	1

Total Number of samples = 35

7.0 BACKFILL HEIGHT

.1	0 - 4 ft	1
.2	4 ft - 5 ft	6
.3	5 ft - 6 ft	19
.4	6 ft - 7 ft	4
.5	7 ft - 8 ft	2

Total Number of samples = 32

8.0 FRAMING STRAPS INSTALLED

.1	Yes	29
.2	No	2
.3	Unable to determine	1

Total Number of samples = 32

9.0 FRAMING ANCHORS INSTALLED

.1	Yes	24
.2	No	1
.3	Unable to determine	7

Total Number of samples = 32

10.0 MAIN FLOOR FRAMING

.10 BEAMS

.1	3 Ply 2x10	9
.2	4 Ply 2x10	8
.3	3 Ply 2x12	1
.4	4 Ply 2x12	1
.5	glu-lam	1
.6	None	6
.7	Other See page B10 for break down of other.	

Total Number of samples = 26

.20 FLOOR

.1	2x10 @ 16" O.C	22
.2	2x10 @ 12" O.C	1
.3	2x12 @ 16" O.C	0
.4	2x12 @ 12" O.C	0
.5	TJI	0
.6	Floor Trusses	6
.7	Other See page B10 for breakdown of other.	

Total Number of samples = 27

11.0 INTERIOR BRG WALLS

.1	2x4 @ 12" O.C	0
.2	2x4 @ 16" O.C	0
.3	2x6 @ 12" O.C	0
.4	2x6 @ 16" O.C	20
.5	None	12

Total Number of samples = 32

12.0 JOIST BOX SPACE TREATMENT

.10 INSULATION

.1	Fiberglass insulation	25
.2	Styrofoam	1
.3	Nothing	6

Total Number of samples = 32

.20 AIR/VAPOUR BARRIER PERFORMANCE

.1	Excellent	7
.2	Good	1

.3	Fair	6
.4	Poor	1
.5	Nothing	17

Total Number of samples = 32

13.0 SUMP

.10 TYPE

.1	Plywood sump box	20
.2	FIO Drain	2
.3	Other See page B10 and B11 for breakdown of other.	
.4	None	5

Total Number of samples = 32

.20 SUMP ACTIVITY

.1	Continually active	6
.2	Seasonably active	8
.3	Never active	7
.4	Unable to determine	11

Total Number of samples = 32

14.0 BASEMENT FINISHING

.1	0 - 24%	17
.2	25 - 49%	2
.3	50 - 74%	3
.4	75 - 99%	8
.5	100%	2

Total Number of samples = 32

The following is the breakdown of the inspection results that would not fit into the inspection summary.

1. Item 6.50.4 Wall Deflections

   These are the deflections recorded:

   .1 2 3/4" on the 2*6 wall. There was one stud broken. The studs were "All-American" studs from Oregon. The studs had a high number of large knots in them and appear to be a stud grade. The studs were located under a raised patio deck with negative drainage. PWF study #21

   .2 1/2" - 3/4" on a 10'- 0" high wall. PWF study #22

2. Item 10.10.7 Main Floor Framing - Beams

   The following are the other beam types used:

   .1 There is a beam but due to the finishing of the basement we cannot tell what type it is. This applies to PWF study #'s: 5
   13
   14
   15
   18
   19

   .2 3 ply 2*8; PWF study # 17

3. Item 10.20.7 Main Floor Framing - Floor

   The following are the floor types used:

   .1 TTS floor joists; PWF study #15

   .2 2*8 @ 16" o.c.; PWF study #17

   .3 2*8 @ 16" o.c.; PWF study #25

4. Item 13.10.4 Sump Type

   The following are sump types used:

   .1 Custom made metal box

   .2 A sump box filled with washed rock constructed in the side of the hill and covered with fill. This was constructed about 20'-0" from the PWF and about 4'-0" below the bottom of the footing. PWF study #18

.3 During inspection we could not find these sumps. There was no way to determine if they were covered or just simply deleted during construction. This applied to PWF study #'s 14
15
28

Appendix B Inspection and Sampling

Part II A Summary of the Chronological Breakdown of the Test Group.

The years in which the inspected PFW's were built are tabulated on page B13.

YEAR OF CONSTRUCTION	NO. OF HOUSES
1977	1
1978	1
1979	12
1980	3
1981	3
1982	0
1983	2
1984	0
1985	0
1986	6
1987	2
UNABLE TO DETERMINE	2
Total	32

Appendix C Occupant Questionnaire

The pages in this appendix contain the questions that were asked in the questionnaire and summaries of the responses that were received. Where applicable our commentary has been provided in response to comments made by the person who completed the questionnaire.

OCCUPANT QUESTIONNAIRE

1. When was your home built?
(See page C17 item 1 for breakdown of answers)

2. What year did you move into your residence?
(See page C17 item 2 for breakdown of answers)

3. Would you consent to an investigation of your basement by us at a time that would be convenient for you?

.1 103 yes .2 19 no

Total Number of Responses = 122

4. If you consent to an inspection of the basement and wish to arrange a convenient time by phone, please provide a number, otherwise we will arrange a time by mail.
(Not applicable)

5. Do you own or rent your residence?

.1 128 own .2 1 rent

Total Number of Responses = 129

6. What is the usual number of occupants living in the house?
(See page C17 item 3 for breakdown of answers)

Total Number of Responses = 126

7. How did you choose to use a preserved wood foundation for your house?

.1 28 on the advice of a friend
.2 45 on the basis of advertisements in the paper or trade literature
.3 14 chosen by the builder in consultation with you
.4 9 already there when you bought the house
.5 49 other See page C18 item 4 for breakdown of answers

Total Number of Responses = 145

8. What were the main reasons for deciding to use a preserved wood foundation? (Check as many as apply to you).

.1 46 cost
.2 91 ease of finishing basement
.3 12 past experience
.4 8 not involved in the decision
.5 71 other See page C18 item 5 for breakdown of answers

Total Number of Responses = 228

9. Which of the following organizations/publications did you consult for details on preserved wood foundations?

.1	21	Canadian Wood Council
.2	9	Canadian Institute of Treated Wood
.3	24	Canadian Standards Association
.4	27	assumed the builder knew what he had to do
.5	64	other information See page C19 item 6 for breakdown of answers

Total Number of Responses = 145

10. How was the construction of your house managed?

.1	13	by the builder
.2	57	by yourself, employing a builder
.3	60	by yourself, doing most of the building yourself
.5	2	other See page C18 item 7 for breakdown of answers

Total Number of Responses = 132

11. How would you describe the comfort level in the basement living space?

.1	0	uncomfortably humid	.4	2	uncomfortably dry
.2	35	comfortably humid	.5	9	no opinion
.3	88	comfortably dry			

Total Number of Responses = 134

12. If you have noted any odours in your basement, do they smell like (check as many as apply)

.1	12	a new house	.6	0	garlic
.2	6	dust	.7	16	earthy or musty
.3	2	fuel oil	.8	31	same as upstairs
.4	0	smelly running shoes	.9	74	no smell noted
.5	5	pets	.10	5	other See page C19 item 8 for breakdown of answers.

Total Number of Responses = 151

13. Which of the following words best describe the living conditions in your basement during winter? (check as many as apply)

.1	51	cosy	.7	23	dry
.2	8	humid	.8	1	stale
.3	9	cold	.9	1	hot
.4	56	warm	.10	63	even temperature
.5	4	drafty	.11	12	other
.6	67	pleasant			

Total Number of Responses = 295

14. What is the R-value of the house exterior wall?

.1	8	10 - 15
.2	24	15 - 20
.3	65	20 - 30
.4	16	30 - 40
.5	9	40 - 50

Total Number of Responses = 122

15. What type of windows are in the house?

.1	89	wood double glazed
.2	21	wood triple glazed
.3	8	vinyl double glazed
.4	4	vinyl triple glazed
.5	23	aluminum or vinyl sliders
.6	6	other See page C19 item 9 for breakdown of answers

Total Number of Responses = 151

16. During cold weather does moisture appear on:

			Yes	No
.1	56	windows	66	54
.2	33	window sills		
.3	1	skylights		

Total Number of Responses = 120

17. Which of the following mechanisms do you rely on for fresh air for your house?

.1	16	air-to-air heat exchanger
.2	19	forced fresh air fan with no heat recovery
.3	76	natural ventilation (no special equipment)
.4	62	windows

Total Number of Responses = 173

18. Which of the following do you rely on for providing adequate humidity during the winter?

.1	53	humidifier on the furnace
.2	23	stand-alone humidifier
.3	51	no humidifier

Total Number of Responses = 127

19. If you have a humidifier on the furnace is it controlled by a humidistat?

.1	40	yes
.2	30	no

Total Number of Responses = 70

20. Is part or all of the house air conditioned in the summer time?

.1	2	one or two window air conditioners used
.2	1	central air conditioning used
.3	124	no air conditioning used

Total Number of Responses = 127

21. How do you dry your clothing?

.1	115	use a clothes dryer most or all of the time
.2	24	hang clothes to dry outside in the summer
.3	4	hang clothes to dry inside in the winter

Total Number of Responses = 143

22. If you use a clothes dryer is the dryer vented to the outside?

.1	119	yes
.2	7	no

Total Number of Responses = 126

23. Where is your clothes dryer located?

.1	53	main floor
.2	6	third level on a split
.3	68	basement
.4	0	do not have one

Total Number of Responses = 127

24. Which of the following heating systems do you have? (check all systems that apply)

.1	94	oil or gas fired forced air furnace with a chimney
.2	14	oil or gas fired forced air high efficiency furnace with no chimney
.3	2	electrical baseboard heating
.4	2	electrical furnace with forced air
.5	0	heat pump with conbustion heating back-up
.6	0	heat pump with combustion heating back-up
.7	37	wood burning fireplace
.8	24	wood burning stove
.9	1	solar heating
.10	17	hot water heating
.11	14	air-to-air heat exchanger

Total Number of Responses = 205

25. Is there a fresh air supply from outside provided for any of your combustion heating devices?

.1 107 yes .2 12 no 3. 6 don't know

Total Number of Responses = 125

26. What combustion appliances do you have?

.1 12 gas stove
.2 15 gas dryer
.3 55 none at all
.4 41 other See page C19 item 10 for breakdown of answers

Total Number of Responses = 123

27. Do these appliances have their own combustion air?

.1 33 yes .2 28 no

Total Number of Responses = 61

28. Which of the following do you have in your basement?

			Yes
.1	bedrooms used on a daily basis		45
.2	bedrooms used occasionally		66
.3	rumpus, family or activity room		96
.4	furnace and utility room		118
.5	laundry room		65
.6	heated storage room		61
.7	cold storage room		68
.8	bathroom If yes, does it have		83
	.8a	a shower cabinet	50
	.8b	a tub/shower combination	24
	.8c	a tub only	2
.9	children's play room		49
.10	office		39
.11	other (please specify)		29
	.11a	See page C20 item 11 for breakdown of answers	
	.11b	See page C20 item 11 for breakdown of answers	
	.11c	See page C20 item 11 for breakdown of answers	
	.11d	See page C20 item 11 for breakdown of answers	
	.11e	See page C20 item 11 for breakdown of answers	
	.11f	See page C20 item 11 for breakdown of answers	

Total Number of Responses = 794

29. How many levels does your wood basement have?

.1 119 the whole basement is at the same level
.2 9 there are two levels
.3 0 there are more than two levels

Total Number of Responses = 128

30. How many lineal feet of foundation walls are there, i.e. what is the perimeter of the house? (insert the number of feet in the spaces provided)
(See page C20 item 12 for breakdown of answers)

Total Number of Responses = 110

31. How many corners are there in the outside perimeter of the house? (For example, a simple rectangular plan would have 4 corners. Other more complex shapes could have 6, 8 or more corners. Count a corner for each place that a foundation wall changes direction and insert the number in the spaces provided.)
(See page C21 item 13 for breakdown of answers)

Total Number of Responses = 126

32. What is the maximum number of stories carried by the preserved wood foundation? (Count each floor level above the basement)

.1 3 no additional stories
.2 96 1 storey
.3 28 2 stories
.4 1 3 stories

Total Number of Responses = 128

33. To what degree have the preserved wood foundation walls been finished? (with paneling, gypsum drywall, or other panel materials)

.1 10 not at all
.2 18 partly
.3 28 mostly
.4 73 completely finished

Total Number of Responses = 129

34. If some finishing of the preserved wood wall has been done, which of the following materials has been used? (check all applicable boxes)

.1 104 gypsum board
.2 29 wood produce paneling
.3 100 plastic vapour barrier

.4 105 insulation (full thickness)
.5 6 insulation (partial thickness)
.6 0 other See page C21 item 14 for breakdown of answers

Total Number of Responses = 344

35. Before backfilling of the soil against the foundation, were the joints between the plywood sheets caulked?

.1 113 yes .2 3 no .3 11 don't know

Total Number of Responses = 127

36. Before the backfilling of the soil against the foundation, some form of damp proofing is usually applied to the foundation walls to inhibit moisture from the soil from coming into the foundation. What type was used for your foundation below the ground line?

.1 78 plastic sheeting
.2 70 asphalt coating
.3 11 resin coating
.4 7 don't know
.5 5 other See page C22 item 15 for breakdown of answers

Total Number of Responses = 171

37. If insulation was applied to the outside of the basement wall, what type was used?

.1 10 rigid plastic foam
.2 3 semi-rigid fibre insulation
.3 82 none on the outside
.4 7 don't know
.5 1 other See page C2 item 16 for breakdown of answers

Total Number of Responses = 103

38. How is the exterior of the preserved wood foundation finished from the first floor level to soil level?

.1 9 brick extends to soil
.2 79 cement parging
.3 0 asbestos cement board
.4 7 paint or other coating
.5 49 other See page C21 item 17 for breakdown of answers

Total Number of Responses = 144

39. What is the outside finish of the outside walls on the first floor level above the basement level? (check as many of the types below as apply)

.1 41 hardboard siding

.2	10	aluminum or steel siding
.3	36	vinyl siding
.4	22	brick or stone veneer
.5	25	stucco
.6	4	plywood siding
.7	25	other See page C22 item 18 for breakdown of answers

Total Number of Responses = 163

40. Concerning the support for the wood foundation, is the foundation located?

.1	78	primarily on soil
.2	39	primarily on rock
.3	8	don't know

Total Number of Responses = 125

41. When the wood foundation was built, were the walls placed on

.1	43	a concrete footing pad
.2	80	a gravel layer over the soil
.3	3	don't know
.4	4	other See page C22 item 19 for breakdown of answers

Total Number of Responses = 130

42. Did construction of the preserved wood foundation take place entirely or partly during a winter period?

.1	18	yes
.2	104	no
.3	6	don't know

Total Number of Responses = 128

43. Was the foundation exposed to the weather for an extended period before construction of the remainder of the house?

.1	77	less than 1 month
.2	18	1 - 2 months
.3	15	2 - 4 months
.4	6	more than 4 months
.5	9	don't know

Total Number of Responses = 125

44. If you are aware of the conditions of the preserved wood foundation at time of construction (including the time the superstructure or part of it was constructed), was the excavation

.1	19	wet
.2	50	well drained even though rain fell
.3	53	dry
.4	4	frozen
.5	3	other See page C23 item 20 for breakdown of answers

Total Number of Responses = 129

45. What construction is used in the basement or lowest floor? (Check as many as are used)

.1 12 a suspended wooden floor (a wooden floor with a crawl space underneath)
.2 29 a wooden sleeper floor (where the floor joists or sleepers rest directly on ground)
.3 88 a poured concrete floor slab
.4 1 don't know

Total Number of Responses = 130

46. If the basement floor is of wooden construction, is there (check as many as apply)

.1 29 a gravel or sand bed below it
.2 34 a moisture barrier consisting of plastic or building paper
.3 28 crushed rock
.4 1 cannot determine what is under the floor

Total Number of Responses = 92

47. Was there a weeping tile drain installed at the base of the foundation around the perimeter of the house?

.1 39 yes .2 80 no .3 7 don't know

Total Number of Responses = 126

48. What backfilling material was used to fill in the excavation against the preserved wood foundation (not counting top soil that might have been put on for grass)

.1 90 gravel or sand
.2 21 silty soil
.3 33 clay
.4 5 don't know

Total Number of Responses = 149

49. How high is the maximum soil height above the basement floor?

.1 3 under 3 feet
.2 30 3 to 4 feet
.3 41 4 to 5 feet
.4 29 5 to 6 feet
.5 19 6 to 7 feet
.6 12 7 to 8 feet
.7 1 over 8 feet

Total Number of Responses = 135

50. How high is the maximum soil height above the basement floor.

.1 12 the basement floor is at or above grade
.2 2 from 1 to 2 feet
.3 2 from 2 to 3 feet
.4 41 from 3 to 4 feet
.5 40 from 4 to 5 feet
.6 24 from 5 to 6 feet
.7 4 from 6 to 7 feet
.8 1 from 7 to 8feet
.9 0 over 8 feet

Total Number of Responses = 126

51. How high are the preserved wood foundation walls?

.1 2 4 to 6 feet
.2 10 6 to 8 feet
.3 90 8 feet
.4 19 8 to 9 feet
.5 18 over 9 feet

Total Number of Responses = 139

52. Is the house constructed on terrain that is

.1 45 sloped
.2 83 mostly flat
.3 0 other See page C22 item 21 for breakdown of answers

Total Number of Responses = 128

53. Does the ground slope away from the house all around?

.1 74 yes
.2 17 level all around
.3 24 yes, except on one side where it is level
.4 15 yes, except a few places where it slopes toward the house
.5 0 no, slope is generally toward the house all around

Total Number of Responses = 130

54. Does the ground slope away from the house all around?

.1 73 no
.2 44 partly (on one side or corner)
.3 9 yes (all around)

Total Number of Responses = 126

55. If there is a lake or stream nearby, what is the level of the body of water relative to the basement floor?

.1 5 within 3 feet
.2 3 between 3 and 5 feet
.3 4 between 5 and 10 feet
.4 17 greater than 10 feet
.5 6 cannot estimate
.6 82 no lake or stream

Total Number of Responses = 117

56. If there is a lake or stream nearby, what is the distance of the body of water from the foundation?

.1	1	0 to 50 feet
.2	2	50 to 100 feet
.3	4	100 to 200 feet
.4	8	200 to 500 feet
.5	7	500 to 1000 feet
.6	23	over 1000 feet

Total Number of Responses = 45

57. If you have a sump pump, when was it installed?

.1	37	at time of construction
.2	2	after you moved in
.3	71	not at all

Total Number of Responses = 110

58. If you have a sump pump, when does it operate more frequently?

.1	0	winter
.2	18	spring
.3	11	summer
.4	1	autumn
.5	1	about the same all year round
.6	38	not at all

Total Number of Responses = 69

59. What is the distance in inches from the basement floor to the water level in the sump pump?
(See page C23 item 22 for breakdown of answers)

Total Number of Responses = 69

60. Where there any water leaks into the basement after you moved in?

.1	9	yes	.2	116	no	.3	1	don't know

Total Number of Responses = 126

61. Have you had any serious flooding in the basement?

Yes	No
7	99

If yes, what was the reason for this flooding?

.1	3	blocked drain
.2	3	back
.3	0	general flood conditions outside

.4 0 flooding but don't know cause
.5 18 no flooding
.6 3 other See page C23 item 23 for breakdown of answers

Total Number of Responses = 107

62. Have you had any water problems in your basement that were not the result of water or sewer line leakage?

.1 7 yes .2 121 no

Total Number of Responses = 128

63. If there were any leaks, how were they repaired?

.1 4 leaks not repaired yet
.2 3 excavation of soil outside and recaulking
.3 2 attemt to fix leak from inside
.4 1 other See page C23 item 24 for breakdown of answers

Total Number of Responses = 10

64. Have you experienced any of the following problems in your home?

		Yes	No
.1	doors sticking	39	88
	If yes, did this occur on		
.1a	basement floor level	8	
.1b	main floor level	32	
.1c	second floor level	4	
.1d	other See page C23 item 25 for breakdown of answers	3	

Total Number of Responses = 127

		Yes	No
.2	cracking in the ceiling drywall	27	100
	If yes, did this occur on		
.2a	basement level	0	100
.2b	main floor ceiling	22	
.2c	second floor ceiling	6	
.2d	other See page C23 item 25 for breakdown of answers	0	

Total Number of Responses = 127

		Yes	No
.3	cracking of the drywall on the walls.	28	99

If yes, did this occur on

.3a	basement walls	4
.3b	main floor	23
.3c	second floor	7
.3d	other See page C24 item 25 for breakdown of answers	2

Total Number of Responses = 127

		Yes	No
4.	movement of attached garage	5	121

Total Number of Responses = 126

65. Have you experienced any of the following problems with the basement floor of your residence?

		Yes	No
.1	settling	8	120
.2	heaving	4	124
.3	cracking if floor is concrete	27	101
.4	separating if floor is wood	1	127

Total Number of Responses = 512

66. How many people do you know of that have a house built on a preserved wood foundation?

.1	22	0
.2	74	1 to 5
.3	15	5 to 10
.4	16	more than 10

Total Number of Responses = 127

67a. Do any of the above people have problems with their preserved wood foundation?

.1	9	yes	.3	1
.2	88	no	.4	0

Total Number of Responses = 98

67b. How would you rate the finishability of your preserved wood foundation compared to a concrete basement as it relates to

		easier	more difficult
.1	exterior of wall above grade	100	24
.2	installation of windows	117	7
.3	insulating	123	1
.4	installing air/vapour barrier	121	3
.5	installing finish paneling	122	2

Total Number of Responses = 620

68. Have you had to pay extra for homeowner's insurance because you have a preserved wood foundation?

.1 1 yes 2. 95 no .3 32 don't know

Total Number of Responses = 128

69. Have you heard any statements indicating that the resale value of your home may be lower because you have a preserved wood foundation?

.1 17 yes .2 92 no .3 19 don't know

Total Number of Responses = 128

70. Concerning the performance of the preserved wood foundation basement during your occupancy, how would you rate it relative to basements of other houses you have lived in?

.1 0 worse .3 102 better
.2 13 about the same .4 13 no opinion

Total Number of Responses = 128

71. Would you recommend to your acquaintances that they construct a preserved wood foundation?

.1 121 yes
.2 7 no

Total Number of Responses = 128

72. If you were to build a new home tomorrow, would you use a preserved wood foundation?

.1 119 yes
.2 8 no

Total Number of Responses = 127

73. Comments or suggestions concerning preserved wood foundations.
(See pages C24 item 26 for breakdown of answers)

The following are the summaries of the responses to specific questions as noted.

1. The following is the breakdown of the number of responses for each of the calendar years given in question 2.

Year of construction		Number of Responses
.1	1912	2
.2	1919	1
.3	1950	1
.4	1952	1
.5	1956	2
.6	1977	1
.7	1978	6
.8	1979	17
.9	1980	11
.10	1981	20
.11	1982	12
.12	1983	14
.13	1984	13
.14	1985	9
.15	1986	14
.16	1987	2
No Response		2

Total Number of Responses = 128

2. The following are the responses given in question 2.

Year Moved In		Number of Responses
.1	1969	1
.2	1971	1
.3	1975	1
.4	1976	1
.5	1978	6
.6	1979	12
.7	1980	13
.8	1981	19
.9	1982	9
.10	1983	18
.11	1984	10
.12	1985	14
.13	1986	15
.14	1987	6
No Response		2

Total Number of Responses = 128

3. The following are the responses given in question 6.

Number of Occupants		Number of Responses
.1	varies	1
.2	1	1

.3	2	28
.4	3	19
.5	4	38
.6	5	31
.7	6	7
.8	7	1

Total Number of Response = 126

4. The following are the responses given to question 7.5 (other).

Response Given		
.1	based on knowledge required from CHAP	11
.2	advice of family	1
.3	general acquaintance with them (PWF's)	7
.4	researched idea ourselves	5
.5	presentation by woodway basements	1
.6	case of future development	1
.7	cost	2
.8	build it themselves	2
.9	used in previous home	3
.10	from building course	2
.11	personal beliefs in product	6
.12	didn't like concrete	2
.13	energy efficiency	4
.14	referred by Alberta Dept. of Agriculture	1
.15	recommended by Engineer	1

Total Number of Responses = 49

5. The following are the responses given to question 8.5 (other).

Resonse Given		
.1	energy efficient	6
.2	able to build myself	14
.3	warmth	27
.4	faster to build	2
.5	concrete not available	1
.6	easier winter construction	1
.7	adapt foundation to site	2
.8	convenience	1
.9	ease of construction and better insulation	13
.10	to get away from damp walls	3
.11	on advice of others/ literature	1

Total Number of Responses = 71

6. The following are the responses given to question 9.5 (other).

Response Given		
.1	Engineer	10
.2	Brown Engineering	17
.3	CHAP	5
.4	Alberta Dept. of Agriculture	3

.5	CMHC	1
.6	curious/ wanted to try it	1
.7	general literature	7
.8	not involved with the building	3
.9	did not consult	1
.10	Nelson Homes	1
.11	paper ad	1
.12	past owners	4
.13	trade show	1
.14	Revelstoke/ lumber yard	5
.15	contractor	3
.16	NAIT information	1

Total Number of Responses = 64

7. The following are the responses given to question 10.5 (other).

Responses Given

.1	do not know	1
.2	past owner	1

Total Number of REsponses = 2

8. The following are responses given to question 12.10 (other).

Resonses Given

.1	faint, acrid smell, we understand it is from particle board on walls	1
.2	tar and caulking	1
.3	stagnant water	1
.4	odd wood smell/ sawdust	2

Total Number of Responses = 5

9. The following are the responses given to question 15.6 (other).

Responses Given

.1	aluminum 'storefront'	1
.2	wood casement	2
.3	aluminum sliding door	1
.4	have not installed them yet	1
.5	aluminum triple glazed	1

Total Number of Responses = 6

10. The following are the responses given to question 26.4 (other).

Responses Given

.1	water heater	26
.2	furnace	3
.3	fireplace	2
.4	furnace and water heater (gas)	9
.5	wood stove	1

Total Number of Responses = 41

11. The following are the responses given to question 28.11a to f.

Responses Given

.1	workshop	14
.2	living room	1
.3	bar	1
.4	sewing room	4
.5	basement entry	2
.6	hobby room	2
.7	complete kitchen	2
.8	crawl space	4
.9	sauna	5

Total Number of Responses = 35

12. The following are the responses given to question 30.

Lineal Feet of Foundation Wall

.1	95-100	3
.2	101-105	1
.3	106-110	1
.4	111-115	0
.5	116-120	3
.6	121-125	2
.7	126-130	8
.8	131-135	11
.9	136-140	13
.10	141-145	7
.11	146-150	11
.12	151-155	5
.13	156-160	12
.14	161-165	9
.15	166-170	0
.16	171-175	0
.17	176-180	6
.18	181-185	2
.19	186-190	3
.20	191-195	2
.21	196-200	2
.22	201-205	1
.23	214	1
.24	220	1
.25	230	1
.26	240-245	2
.27	254	1
.28	264	1
.29	300	1

Total Number of Responses = 110

13. The following are the responses given to question 31.

.1	4	45
.2	5	4
.3	6	38
.4	7	2
.5	8	21
.6	9	1
.7	10	6
.8	11	2
.9	12	3
.10	14	4

Total Number of Responses = 126

14. The following are the responses given to question 34.6 (other).

Responses Given

No response given to this question.

15. The following are the responses given to question 36.5 (other).

Responses Given		
.1	cardboard	1
.2	base clad insulation	1
.3	1" blue styrofoam insulation	1
.4	weeping tile	1
.5	plastic and water proof insulation	1

Total Number of Responses = 5

16. The following are the responses given to question 37.5 (other).

Responses Given		
.1	rigid at garage wall	1

Total Number of Responses = 1

17. The following are the responses given to question 38.5 (other).

Responses Given		
.1	wood siding above exposed plywood	10
.2	stucco	3
.3	cedar siding	9
.4	artificial rock	1
.5	metal siding	4
.6	none	1
.7	vinyl siding	16
.8	not finished yet	3
.11	stain	2

Total Number of Responses = 49

18. The following are the responses given to question 39.7 (other).

Resonses Given

.1	cedar siding	19
.2	vertical wood boards	2
.3	pressed wood siding	1
.4	log	1
.5	none	1
.6	stain	1

Total Number of Responses = 25

19. The following are the responses given to question 41.4 (other).

Responses Given

.1	concrete piles	1
.2	PWF footer (multi-layered)	3

Total Number of Responses = 4

20. The following are the responses given to question 44.5 (other).

Responses Given

.1	in clay but rain dumped out using sump pump	1
.2	don,t know	2

Total Number of Responses = 3

21. The following are the responses given to question 52.3 (other).

Responses Given

No response given to this question.

22. The following are the responses given to question 59

Responses Given

.1	dry	12
.2	0-5	4
.3	6-10	1
.4	11-15	6
.5	16-20	8
.6	21-25	9
.7	26-30	4
.8	31-40	4
.9	41-60	3
.10	61-80	1

Total Number of Responses = 52

23. The following are the responses given to question 61.6 (other).

Responses Given

.1	poor drainage slope at surface on inside corner	1
.2	incorrect hook-up of weeping tile	1
.3	sump failure	1

Total Number of Responses = 3

24. The following are the responses given to question 63.4

Responses Given

.1	small leak on base plate sealed by wood expansion	1

Total Number of Resonses = 1

25. The following are the responses given to question 64.1d, .2d and .3d (other).

Responses Given

.1	one corner in basement	1
.2	around window frames	1
.3	entrance of bilevel	2
.4	house was lifted onto PWF	1

Total Number of Responses = 5

26. The following are the responses given in question 73.

1. One of neighbours has a wood foundation, engineered by you- but in cutting costs, e.g. pit run gravel under their cement floor and no poly under their floor- they have had more water in their sump than we have. (33)

2. They are a pain to have built. You have to backfill very carefully. The inspectors are the worst as you have to wait and pay for an engineer, and also wait for the city to inspect. Tying in the garage floor to the walls cannot be done, or bolting angle irons in for a brick front. The extra inspections result in delays to backfilling and thereby to the resumption of the construction of the top floor. I found with our first wooden basement, the engineers differed in their opinions regarding the reinforcement of the wall between the garage and basement. (36)

3. We love it. If possible, we'd never have concrete again. We'd probably use an engineer again if we constructed our own P.W.F. again. (38)

4. Our first wood basement home, we built in 1981. We lived there 5 years and had no problems with the basement. It was a bilevel type with 4' backfill, concrete footings, poured slab floor with under slab heat. The basement was completely finished and was as comfortable as the main floor. (48)

5. I would use cement footings rather than P.W.F. plates on gravel because of the problems I encountered in leveling walls during construction. Otherwise I woundn't even consider not using wood again. (49)

6. Finishing was much easier and no forms needed for cement. (55)

7. These basements are excellent. I feel they are very superior to concrete in a number of ways. (56)

8. I would use concrete footings instead of sleepers laying on gravel. Easier to level out foundation when starting. (58)

9. If properly constructed wood foundations are trouble free. Water problems in the basements of our neighbours (concrete foundations) have been encountered, but no problems with water in our basement. (67)

10. At the time of building I probably would not have put in the foundation myself if I could have found a contractor to install to a point ready for backfill. In the design we had headers built into the walls for window opening, this required the window top to be 1' below the top of the foundation which made window wells necessary and limited the size of the windows. (68)

11. I have heard the solution used on the wood to preserve it, is harmful to human beings. (reply please) I also wonder how long until the outside skin of plywood will rot through? (69)

12. High construction standards must be maintained as a deterioration of these standards could detract from the performance of the P.W.F. finished product. Site selection and finished grades around the house are also important. I would be interested in receiving a copy of your report or having an opportunity to look at it. (72)

13. I wouldn't have any other kind of foundation. (70)

14. We beleive our wood basement is warmer and a lot easier to finish. We like it very much. We insulated with R-20 from header to plate and were told we should have a 'R' value of 28 to 30. (73)

14. I have experience bowing of the walls with wood foundations which result in having trouble attaching partitioning walls in the basement. If I was to build again I would insist on closer spacing of studs or doubling every second stud on walls of longer lengths than 15'. My walls have a 1/2" to 1 1/2" bow depending on the length of the walls where there is no other support. This problem seems to be very frequent for wood foundations and my feeling is that this is grounds for future problems. Most people will not own up to this problem for it would affect the resale value of their homes. (79)

15. The only negative aspect of a wood foundation is that it was more expensive than concrete. (82)

16. There seems to be a leak somewhere between where the main body of the house attaches to the attached garage. Water has leaked in through drywalling to concrete pad. During construction ther was a noticeable sag of garage door opening towards the centre of the house. This was re-excavated, a portion of basement cement pad jack-hammered out, and supposedly fixed, but soon after we moved in, water started leaking in. This is the only problem, I'm not sure of the cause, but would sure appreciate a visit from your experts! Thank-you. (83)

17. With regard to questions 57-59, we do not have a sump pump but do have a sump hole. We feel it should require more bracing to guard against hydrostatic pressure. (84)

18. This is my third P.W.F. home and it seems to me there is too much settling after drywall and shingles. Possibly concrete footings are the answer. (87)

19. Only concerns I have might be 20 years from now. So far we are very pleased with our wood basement. We do have ants along the south side of our basement, could they possibly do damage? (88)

20. I am extremely satisfied, I would never build a concrete basement. I hope more people build with wood basements in the future. I hope this helps in your survey. (91)

21. More consumer information should be available. How many wood basements are there in Alberta? How old is the oldest? What is the life expectancy? What problems can we expect? If you have this info., please send some of it to us, as we do have several inquiries a year. (93)

22. In my opinion my basement should have been designed stronger. For example; I am noticing bending of the foundation inwards beside the windows. There were only 2 studs on each side of the windows in the design. If I were to do it again I would probably put 4 of them in. Also, possibly instead of 16" centers I would use 12" centers all around the perimeter. (95)

23. Extremely pleased with P.W.F. Engineer was most helpful. (100)

24. I think they are excellent to build, finish and to live in. (101)

25. Concerning question 50, I have a basement entrance so at the doorway and at an angle along one wall there is from 0'-4' of dirt above the basement floor. During construction the factory pre-fabbed wood foundation was altered so it would sit on the concrete perimeter footing instead of extending four feet below grade at the doorway. We then supported the footing with four feet of concrete. The bearing walls are on concrete pads with a treated 2" x 6" resting on the concrete. The concrete floor was then poured around these walls. The floor rests on about 6" of sand. We have had ants come into the basement alongside the bearing walls. They bring up material which appears to be sand. They have also appeared at the perimeter. They were poisoned each time they appeared but they have appeared numerous times. (102)

26. Only time will tell. (103)

27. Trouble free. (105)

28. Much more practical than concrete foundations. I would use a wood sleeper floor rather than a concrete slab if I were to do it again. (106)

29. The only negative thing I've heard about wooden basements is that the formaldehyde in the wood releases gases into the air we breathe. (107)

30. According to the instructions given to us on the construction of the basement, the results would have been a swimming pool; so we therefore finished the walls and roof prior to vapour barrier, wood sleeper floor and backfilling. We had an excessive amount of rainfall at the time of construction so we were compelled to use an alternative to the plans given to us. (108)

31. Do not build over a long winter period- freezing and expanding causes leveling problems. Build only on concrete footings, internal support should be adjustable jack posts, not a bearing wall due to inconsistancy in settling. (exterior to interior) External drainage or backfill on the immediate exterior wall could be acheived more cheaply and more consistant by the application and fixing of a wire mesh 4" from the wall and then filling the space with washed rock. The top could then be capped and a good drainage would remain during backfill as well as after. (109)

32. I would also recommend to have the basement floor done with preserved wood, because of concrete cracking and coolness and concrete's musty odour. (110)

33. Terry- it was interesting filling this form out as it seems like only last month we built this home. Bob was really busy so I filled it in with his comments. All the best on your survey. Our house is currently up for sale and we will build wood again.

34. Where we put metal insulated siding we were afraid the basement wall would not be able to "breathe", so I drilled two or three 1/2" holes in the upper plate between every stud. I look forward to hearing from you. (116)

35. All around performance, I would say it is better than concrete especially in our cold climate. (117)

36. We put plastic on the outside of our basement walls, on our carpenters advice, and our neighbours used tar. I would like to know what is the best method and I think the builder should be made aware. Anyone that I asked didn't really know. My carpenter did say we couldn't use plastic and tar together because the tar would just eat the plastic. (125)

37. There are still alot of people who don't believe in preserved wood foundations. They are still using concrete. Most people feel they will not-however we have confidence in the information we have gathered over the years- on the positive features of a preserved wood foundation. There should be more educational material available on preserved wood foundations- most people are very skeptical of them and very few are using them. Send out some positive findings etc.- you have to prove to people that they will last for 100 years or whatever. They have to be convinced with reliable facts. I will be interested to hear the comments you have received- Also would appreciate the latest information and reports on preserved wood foundations. (126)

38. I would recommend a P.W.F. basement to anyone; we are totally pleased. The only reservations I might have is if I were building a house in a low area with a high water table. The 2" x 8" plank footing plate has supported the weight very well with literally no settling. Levelling the 2- level footing plate was difficult. If I had to do that over again I would consider a concrete footing. My brother built a log house on a wooden basement which we beefed- up from my engineered plans. The basement is supported by a 2" x 10" footing plate with 2" x 8" studs at 12" centers. The house is a single storey solid log wall consisting of 9 rounds of 14" logs. Ground level on one side is a full 8 feet and zero on the other side with a 4' sunken section of the 12" wall. No problems have been encountered. You would be welcome to inspect this basement as well. (129)

39. Wall studs warping before construction. Care to be taken during backfilling. e.g. 1. Proper filter soil. 2. Operator cannot get to close. 3. No rocks larger than 0.10m. There should be proper drainage under the floor. Special care to be taken at window incasements, supports and cornering. Probably a few I cannot think of, but we still would not have a concrete basement. I noticed that the neighbors wood basement used only 2 mil plastic sheeting, no tarring and did not even tar the nails, and they have more water problems than we do but not sure if it came through. I sure would like to know why there is a musty smell. I thought it came from the sump pump at first but not so sure now. We have a double wide trailer on the basement. (130)

40. It is warmer and drier. We bought a four year old house and had it moved out onto our wood foundation. Old house only had a cellar. (132)

41. I would urge people putting an asphalt coating on the outside below ground rather than plastic sheeting. The plastic has a tendency to slip down with the soil, in settling. (133)

42. I have built 2 other wood basements for rental houses, since our own, and so far have had no problems. Those two units have concrete floors, and forced air heating. (134)

43. In my opinion wood foundations are the way to go, providing the soil conditions and water table are also right. Secondly- preserved wood foundations should be engineered and constructed properly to prevent future problems. (135)

44. Its still standing, it could outlast me. Moved house out for son /86 put on wood also. (136)

45. Warm, relatively easy to work with. No trouble to finish- especially since it was exposed at times during construction. Great not to have to build a frame wall inside for stuffing insulation. In view of new health studies, we question the safety of the wood treatment (e.g. "Penta") during use (i.e. carcinogens) in construction. We did not install drainage weeping tiles or sump pump, even though recommended in your literature, as this area is excellent gravel/ rock drainage. We seem to recall some note about the guarantee pertaining to this- perhaps installation and guarantee of the above could be related to the soil/ area in which the house is being constructed. (137)

46. We are extremely pleased and would like to read the results of this survey and the tests done in our house this summer. (138)

47. We have a problem with cold in winter due to the basement floor being at or above grade on one side. It will probably require insulation applied to the exterior below ground level. Also one side wall is being pushed in by the pressure of the soil. There is no problem with the other side. (135)

48. They should get more publicity. It would appear many people don't know about them. They are very comfortable even though ours is not finished yet. (141)

49. My wood foundation has only 6 mil poly to protect it. I would like to see more protection in this area. (142)

50. If I were to build again the only thing about our preserved wood basement I would do differently would be to have a preserved wood floor as well as walls. Thusly skipping the concrete altogether. (143)

51. I am concerned about the chemicals used to preserve the wood. (145)

52. Much simpler and faster to build. It is warm, and easy to finish interior walls. I have no complaints about wooden basements. (148)

53. Wood basements require less heat- large energy savings. Walls are always warm-not cold and damp like cement. Original house, 24' x 28' is on cement foundation with vapour barrier, insulation and finished walls. Addition 24' x 28'-1/2 crawlspace -1/2 bedroom and basement entrance. The cement side has 5 heat ducts, the wood side has 1 heat duct. Wood basement walls were attached to cement with 4-5" lag bolts each end These bolts are visible. No stress or movement has yet showed. Wood walls sit on 18" wide by 8" deep footings. Cement floor is 2" above footings, holding walls secure. Base soil is heavy clay, undisturbed 4 1/2' below ground level. My special thanks to your firm for consultation on my do-it- myself wood basement. (149)

54. Re- electrical wiring- should be allowed to drill holes in studs near the top or bottom to facilitate easier stringing of wiring. Holes at these positions would not weaken the strength of the wall at those points. At least I don't think it would. (2)

55. My experience is that the cost is greater because of the crushed gravel and backfill sand required. Initially thought it would be cheaper. (12)

56. The wood floor has settled at the exterior walls- Maybe it would have been better with a floating cement floor. (13)

57. We have been very pleased with our wood basement. We have built 4 houses with wood foundations and would definitely build it again. (19)

58. Initial cost was higher for wood basement over cement. However ease of construction and ability to finish exterior walls as well as 'R' value, make wooden basements far superior, without question. (23)

59. What was great when we built, it rained constantly and people building concrete basements were haulted and we were able to continue which was a large plus. (25)

60. We have not lived in this house that long to know how it will last, but my opinion is that if your basement is built on higher ground and is well drained, I don't see why it won't last as long as cement. (29)

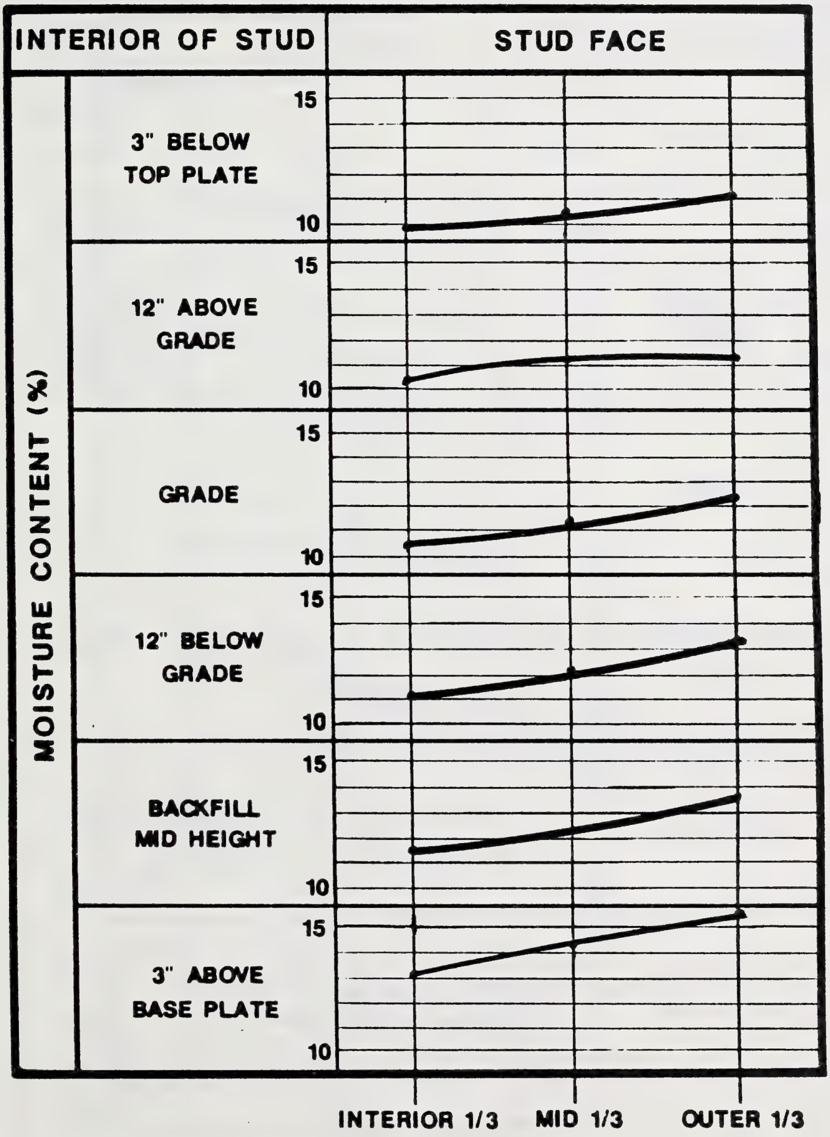
Appendix D Wood Samples

Part I Moisture Profiles Perpendicular to the Grain.

This Part I contains plots of the moisture contents of the three samples taken at each test location. These samples were obtained from the inner, centre and outer one-thirds of the stud. The plot on page D2 contains averages of all the samples, the plot on page D3 contains averages of the samples obtained where the enterior drainage is positive and away from the wall of the house and the plot on page D4 contains averages of the samples obtained where the enterior drainage is negative.

PWF STUD MOISTURE PROFILE

COMBINED DRAINAGE

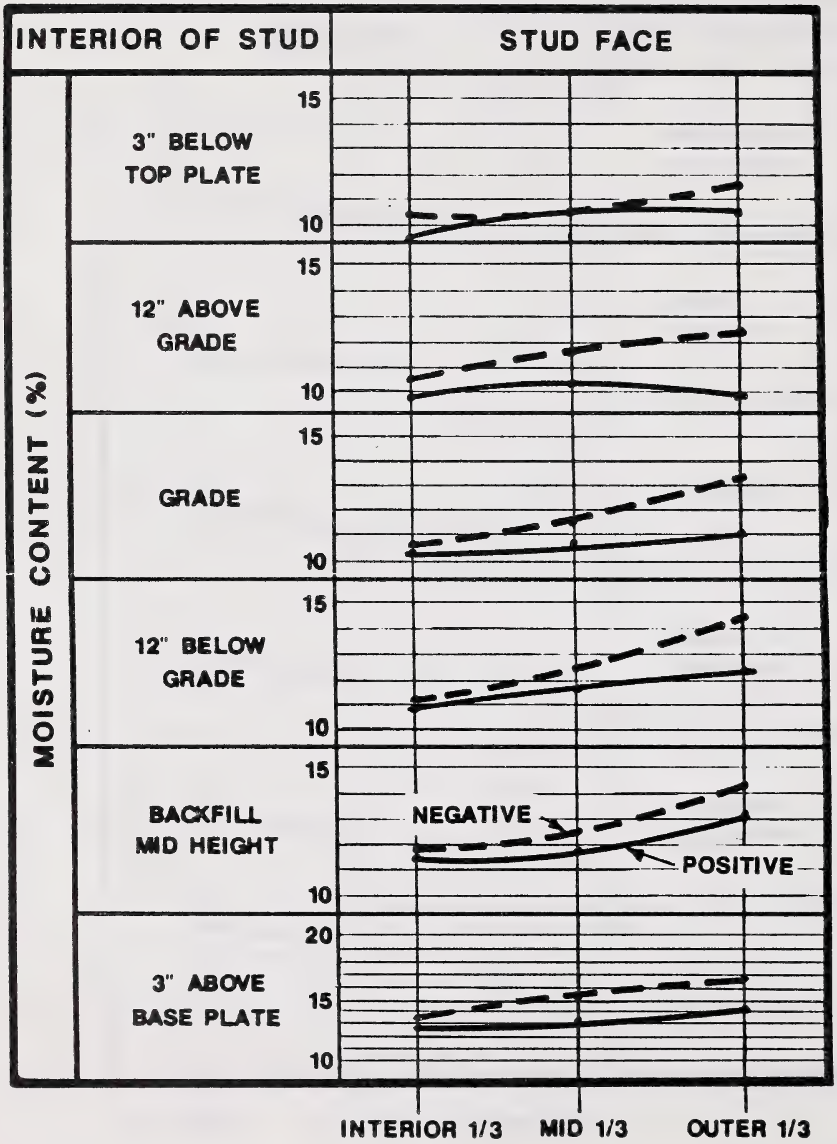


Moisture profiles across face of studs

TOTAL NUMBER OF SAMPLES =782

PWF STUD MOISTURE PROFILE

POSITIVE AND NEGATIVE DRAINAGE



Moisture profiles across face of studs

TOTAL NUMBER OF SAMPLES = 782

MOISTURE PROFILE ACROSS FACE OF PWF STUDS

POSITIVE DRAINAGE

SAMPLE LOCATION	MOISTURE CONTENT (%)		
	INNER 1/3	MIDDLE 1/3	OUTER 1/3
3" BELOW TOP PLATE	9.68	10.50	10.46
12" ABOVE GRADE	9.93	10.20	9.98
GRADE	10.21	10.87	11.00
12" BELOW GRADE	10.96	11.70	12.38
BACKFILL MID HEIGHT	11.49	11.94	13.09
3" ABOVE BASE PLATE	12.73	13.09	14.31

TOTAL NUMBER OF SAMPLES = 351

MOISTURE PROFILE ACROSS FACE OF PWF STUDS

NEGATIVE DRAINAGE

SAMPLE LOCATION	MOISTURE CONTENT (%)		
	INNER 1/3	MIDDLE 1/3	OUTER 1/3
3" BELOW TOP PLATE	10.33	10.55	11.57
12" ABOVE GRADE	10.68	11.82	12.25
GRADE	10.56	11.57	13.25
12" BELOW GRADE	11.09	12.55	14.43
BACKFILL MID HEIGHT	11.81	12.60	14.19
3" ABOVE BASE PLATE	13.38	15.20	16.89

TOTAL NUMBER OF SAMPLES = 431

MOISTURE PROFILE ACROSS FACE OF PWF STUDS

COMBINED DRAINAGE

SAMPLE LOCATION	MOISTURE CONTENT (%)		
	INNER 1/3	MIDDLE 1/3	OUTER 1/3
3" BELOW TOP PLATE	9.99	10.52	11.03
12" ABOVE GRADE	10.35	11.11	11.26
GRADE	10.40	11.24	12.20
12" BELOW GRADE	11.03	12.19	13.43
BACKFILL MID HEIGHT	11.68	12.32	13.73
3" ABOVE BASE PLATE	13.09	14.25	15.73

TOTAL NUMBER OF SAMPLES = 782

Appendix D Wood Samples

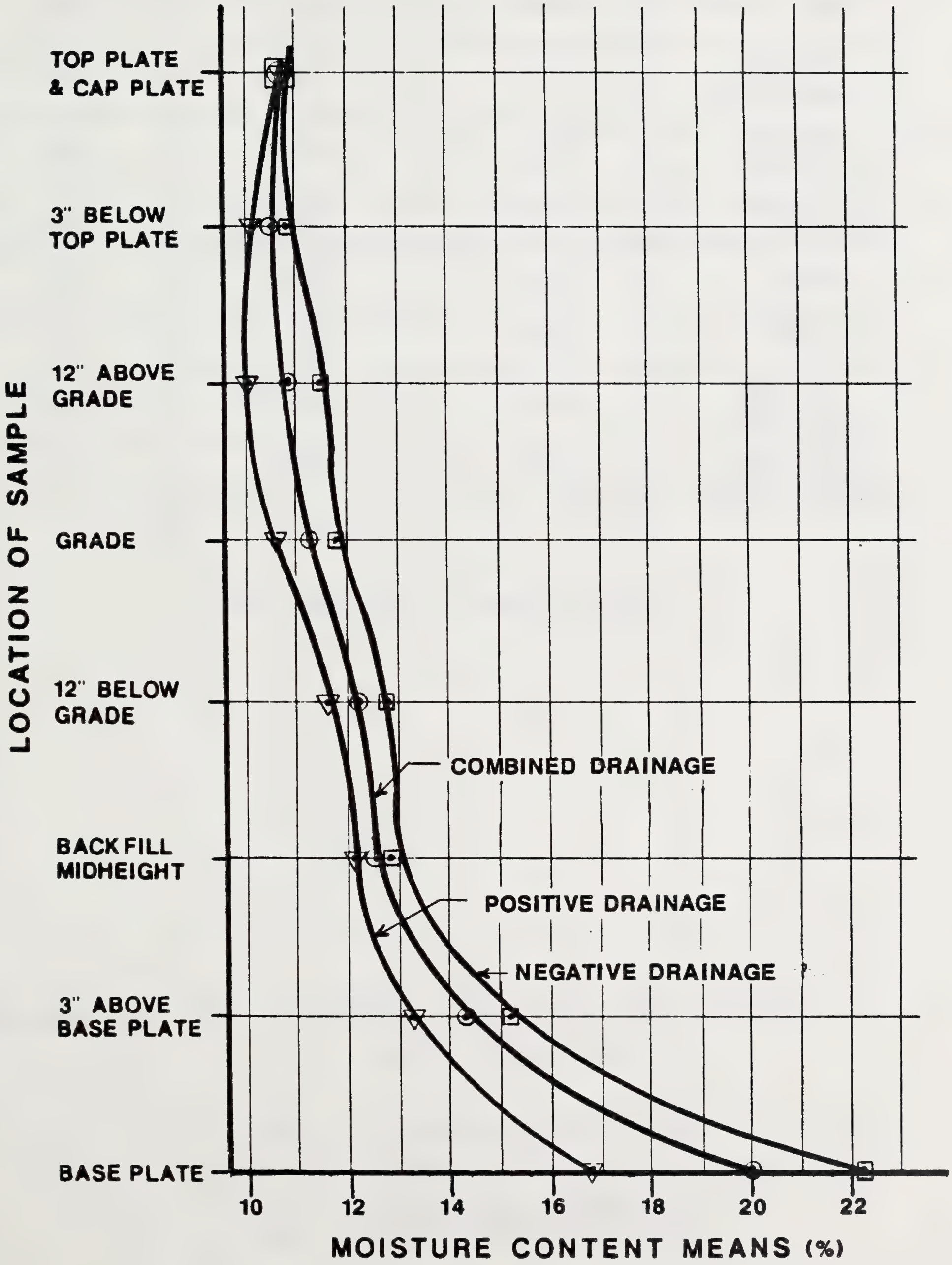
Part II Moisture Content by Sampling Location

The graphs and tables on pages D7 and D8 contain interpretations of the moisture contents of the PWF studs. The plot on page D7 shows the moisture profile for positive, negative and combined drainage. The table on the top of page D8 contains the value of the mean moisture content at the specified testing location for Positive, Negative and Combined Drainage. The table at the bottom of page D8 gives the average of all the moisture contents of the PWF studs.

LOCATION
VS
MOISTURE CONTENT

POSITIVE DRAINAGE, NEGATIVE DRAINAGE AND COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 1011



MOISTURE CONTENT MEAN COMPARISON

FOR THE PWF STUDS & THE BOTTOM PLATE

SAMPLE LOCATION	POSITIVE DRAINAGE	NEGATIVE DRAINAGE	COMBINED POSITIVE & NEGATIVE DRAINAGE
BASE PLATE	16.82	22.18	20.08
3" ABOVE BASE PLATE	13.37	15.18	14.37
BACKFILL MID HEIGHT	12.17	12.86	12.57
12" BELOW GRADE	11.60	12.83	12.22
GRADE	10.69	11.79	11.28
12" ABOVE GRADE	10.04	11.58	10.91
3" BELOW TOP PLATE	10.20	10.81	10.52
TOP PLATE & CAP PLATE	10.76	10.84	10.73

TOTAL NUMBER OF SAMPLES = 907

MOISTURE CONTENT AVERAGE OF ALL MEANS

FOR THE PWF STUDS

1. POSITIVE DRAINAGE = 11.26
2. NEGATIVE DRAINAGE = 12.27
3. COMBINED POSITIVE & NEGATIVE DRAINAGE = 11.80

Appendix D Wood Samples

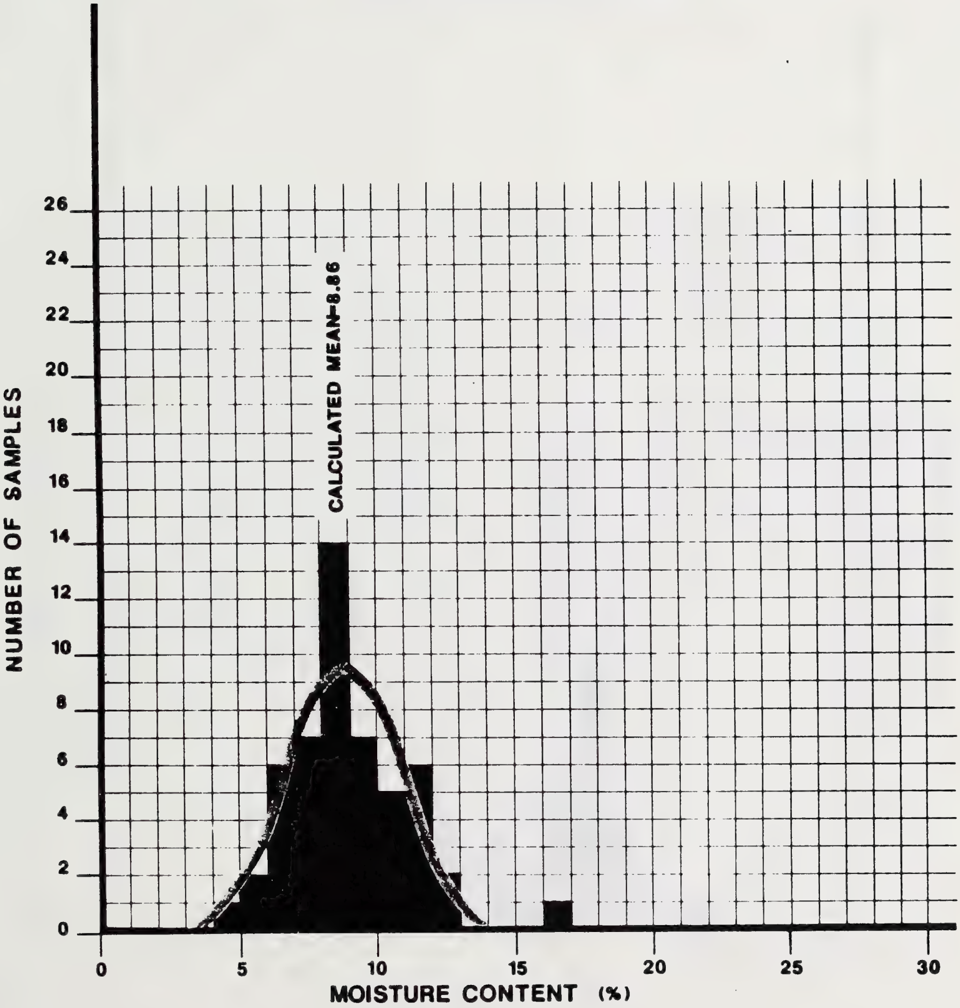
Part III Moisture Contents with Combined Negative and Positive Drainage.

The plots on pages D10 to D20 are normal distribution plots of all of the moisture contents obtained, the calculated mean, and the best fit normal distribution curve.

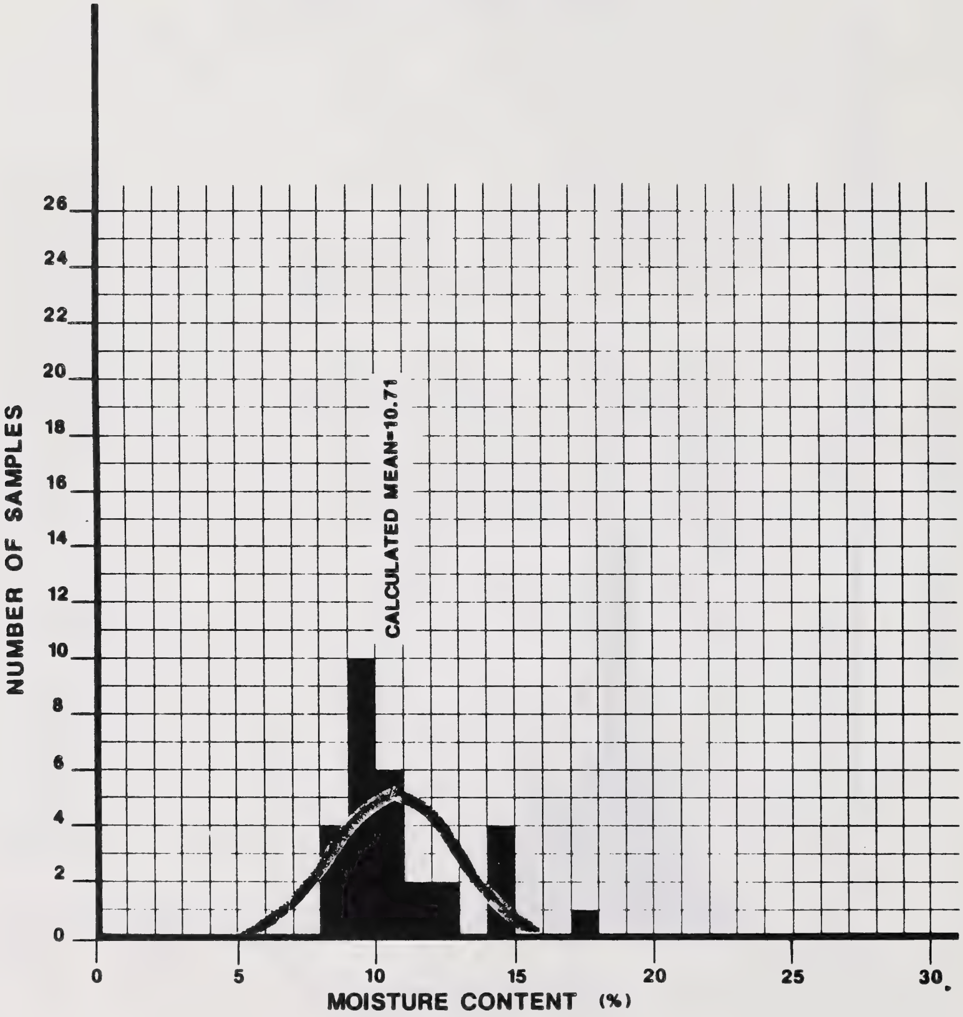
FLOOR JOISTS

COMBINED DRAINAGE

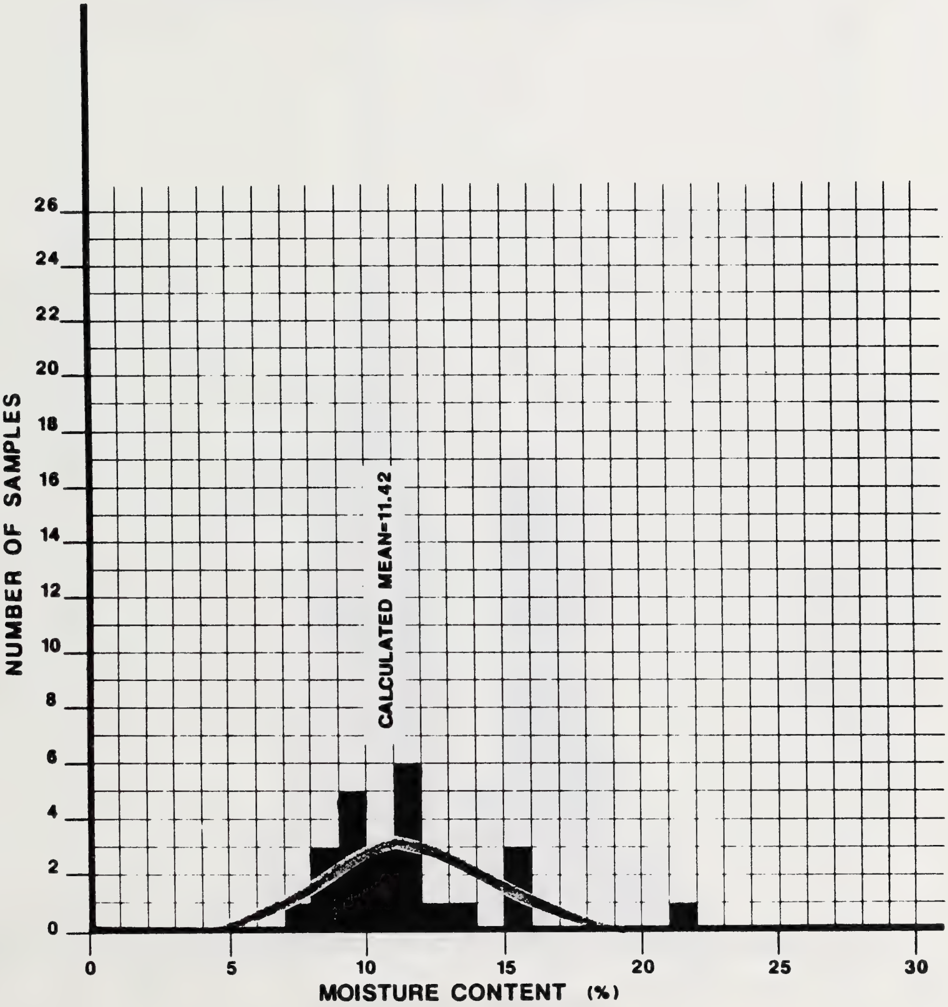
TOTAL NUMBER OF SAMPLES = 51



INTERIOR STUD
3" ABOVE BASE PLATE
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES = 29



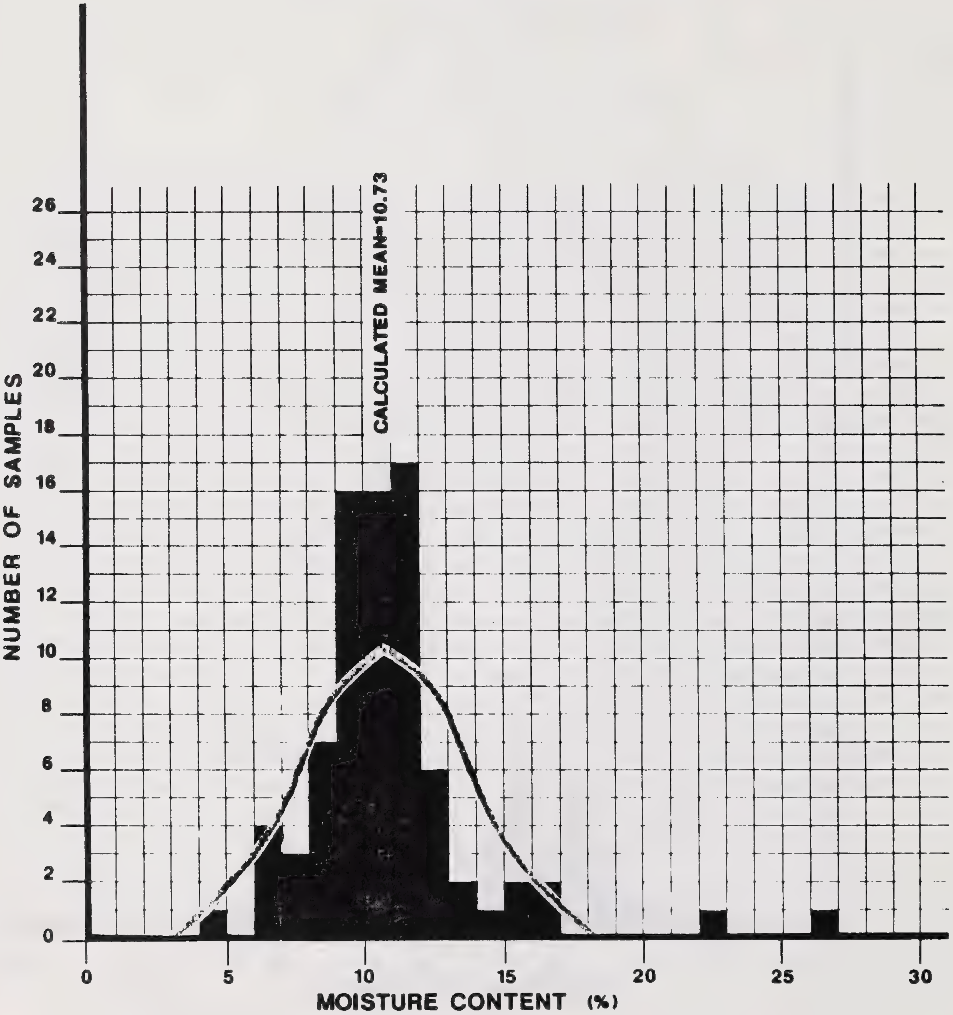
INTERIOR STUD
BASE PLATE
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES = 24



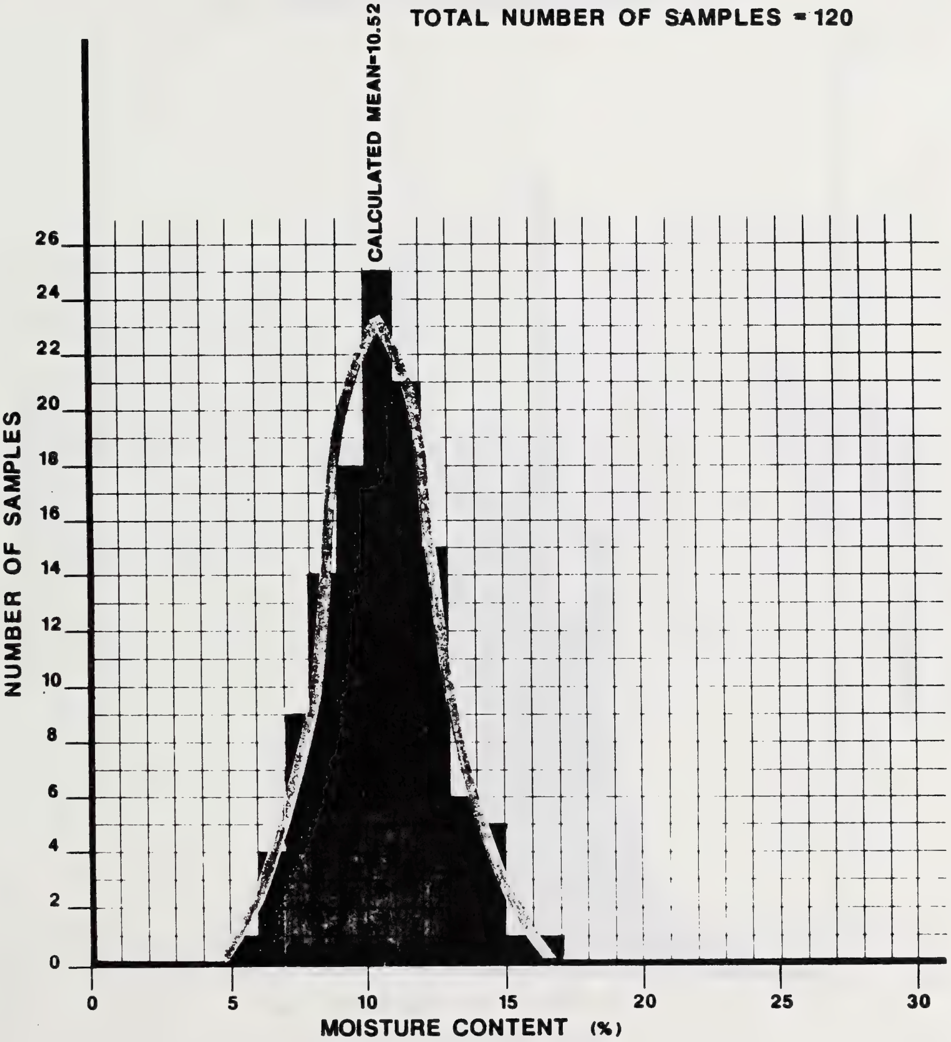
EXTERIOR STUD
TOP PLATE AND CAP PLATE

COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 79

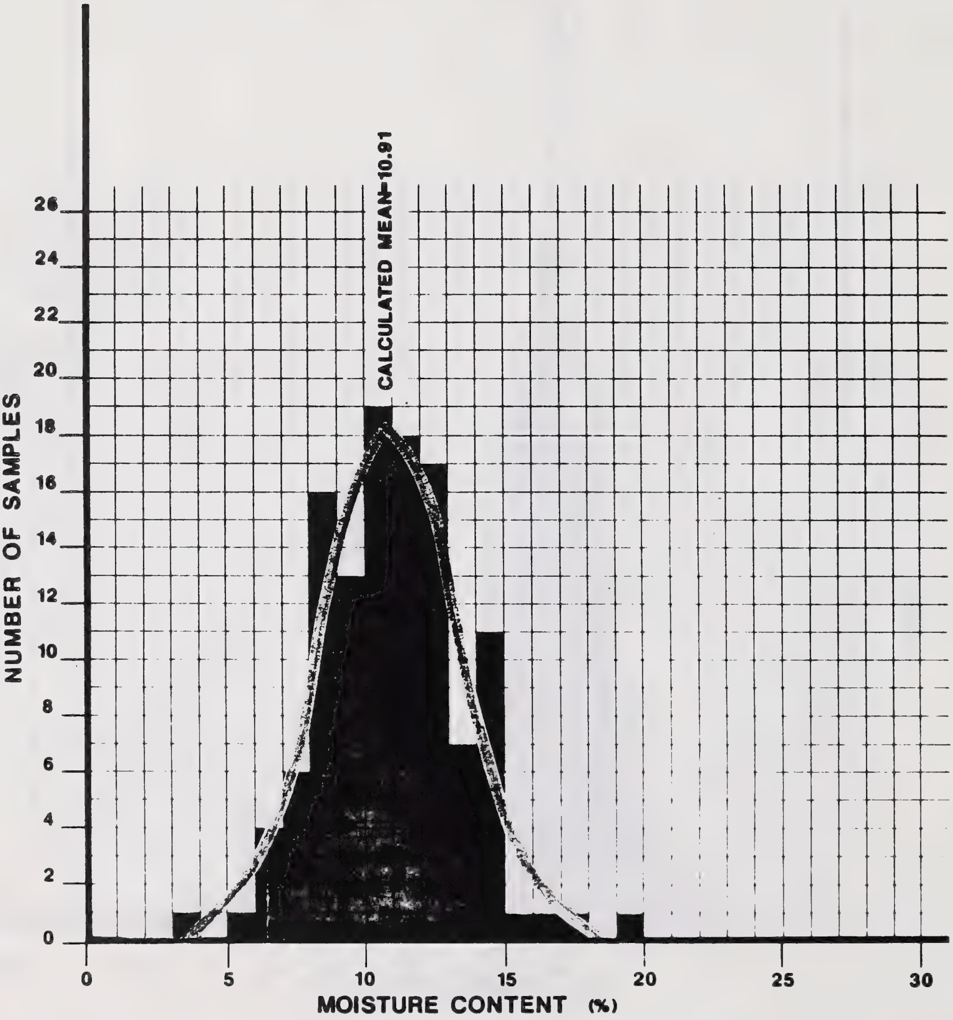


EXTERIOR STUD
3" BELOW TOP PLATE
COMBINED DRAINAGE



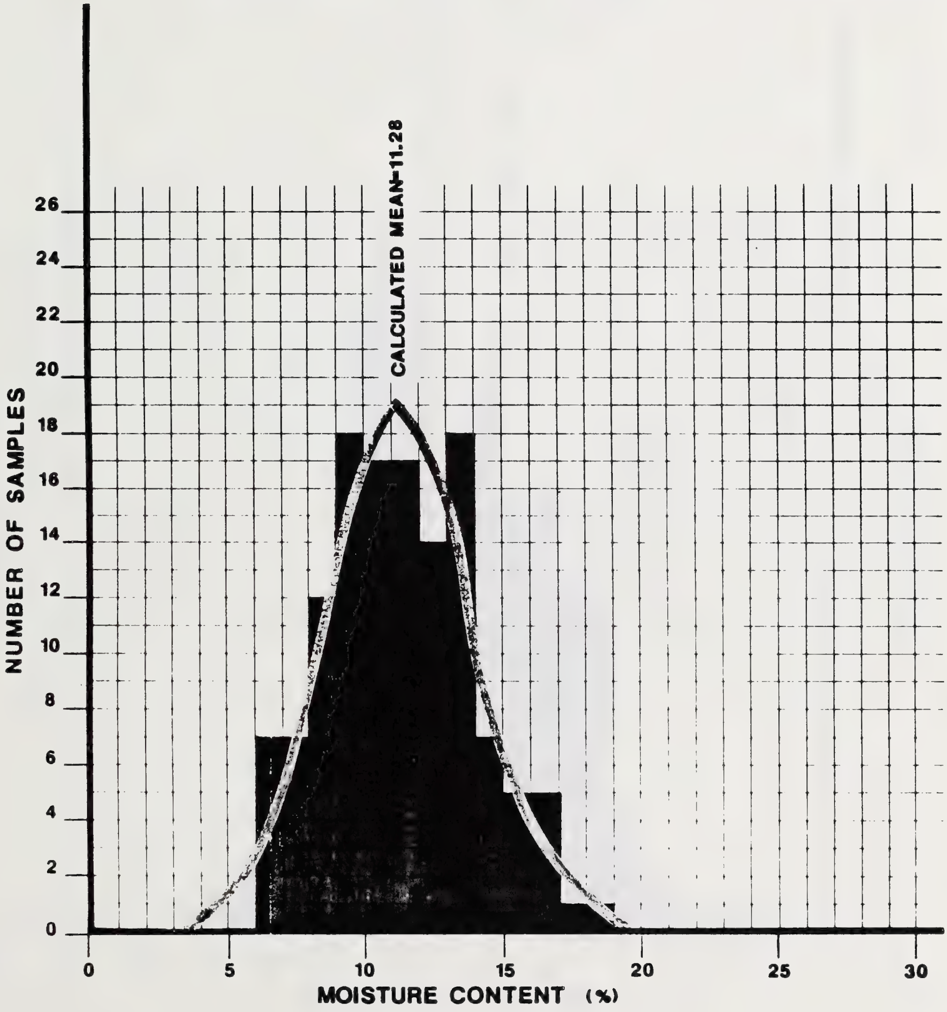
EXTERIOR STUD
12" ABOVE GRADE
COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 117



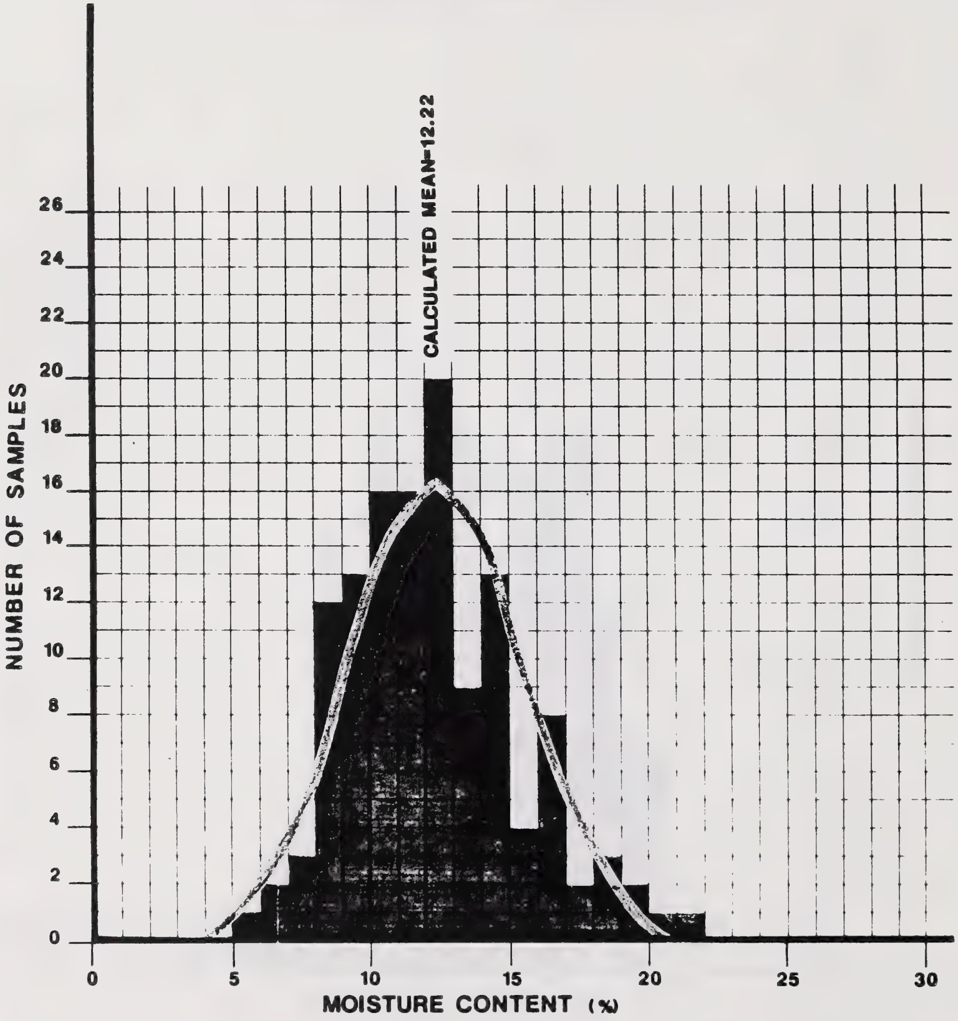
EXTERIOR STUD
TOP OF GRADE
COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 129



EXTERIOR STUD
12" BELOW GRADE
COMBINED DRAINAGE

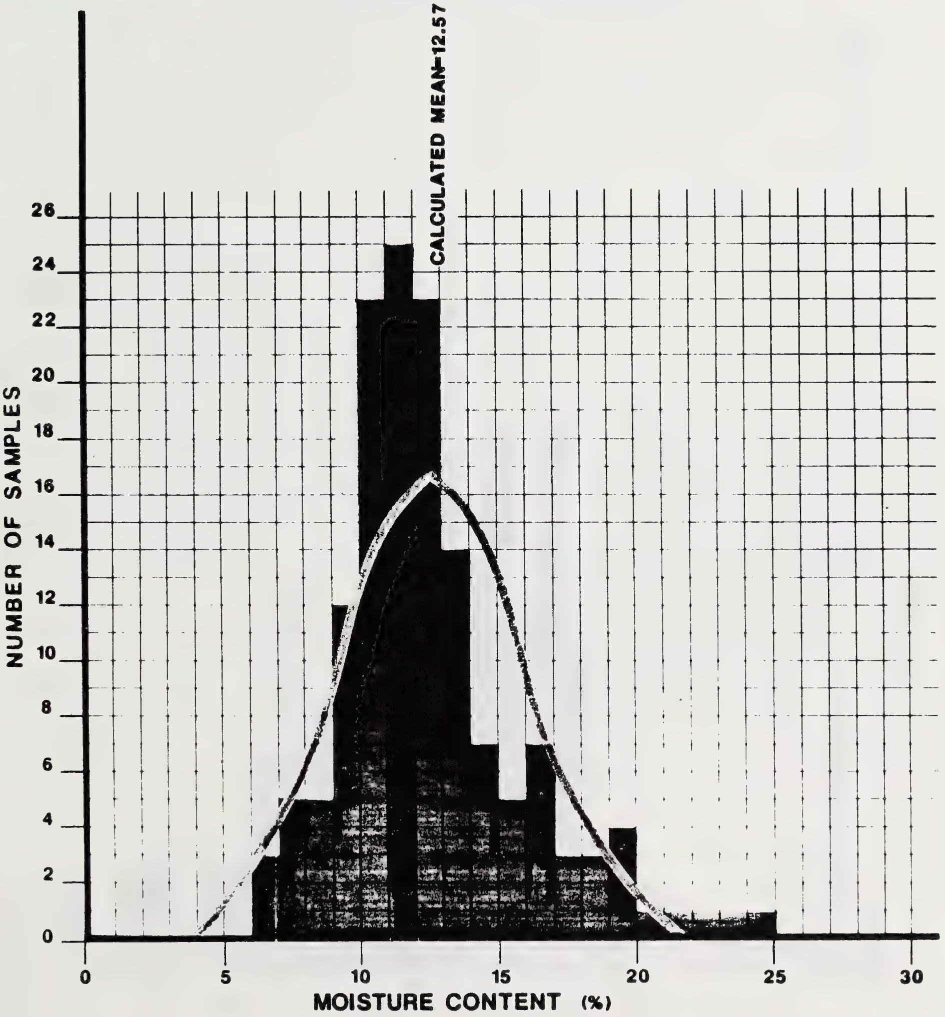
TOTAL NUMBER OF SAMPLES = 126



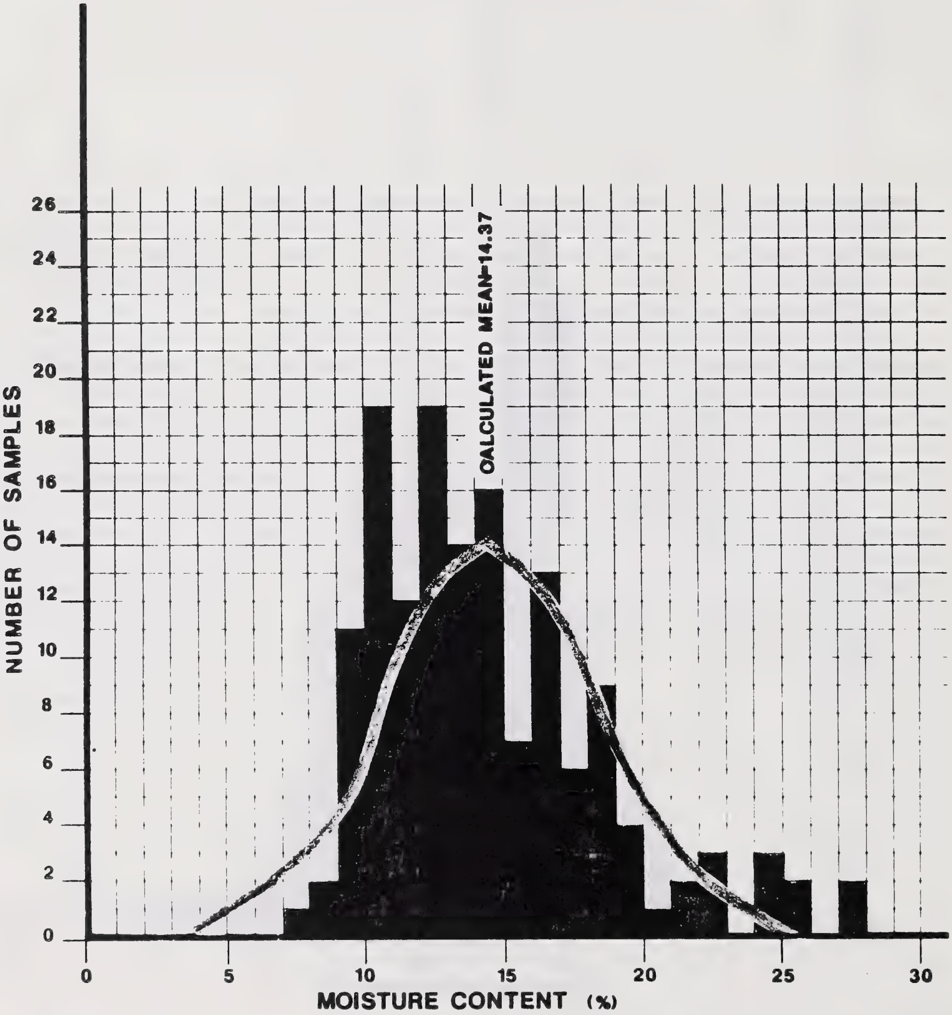
EXTERIOR STUD
MID HEIGHT OF BACKFILL

COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 144



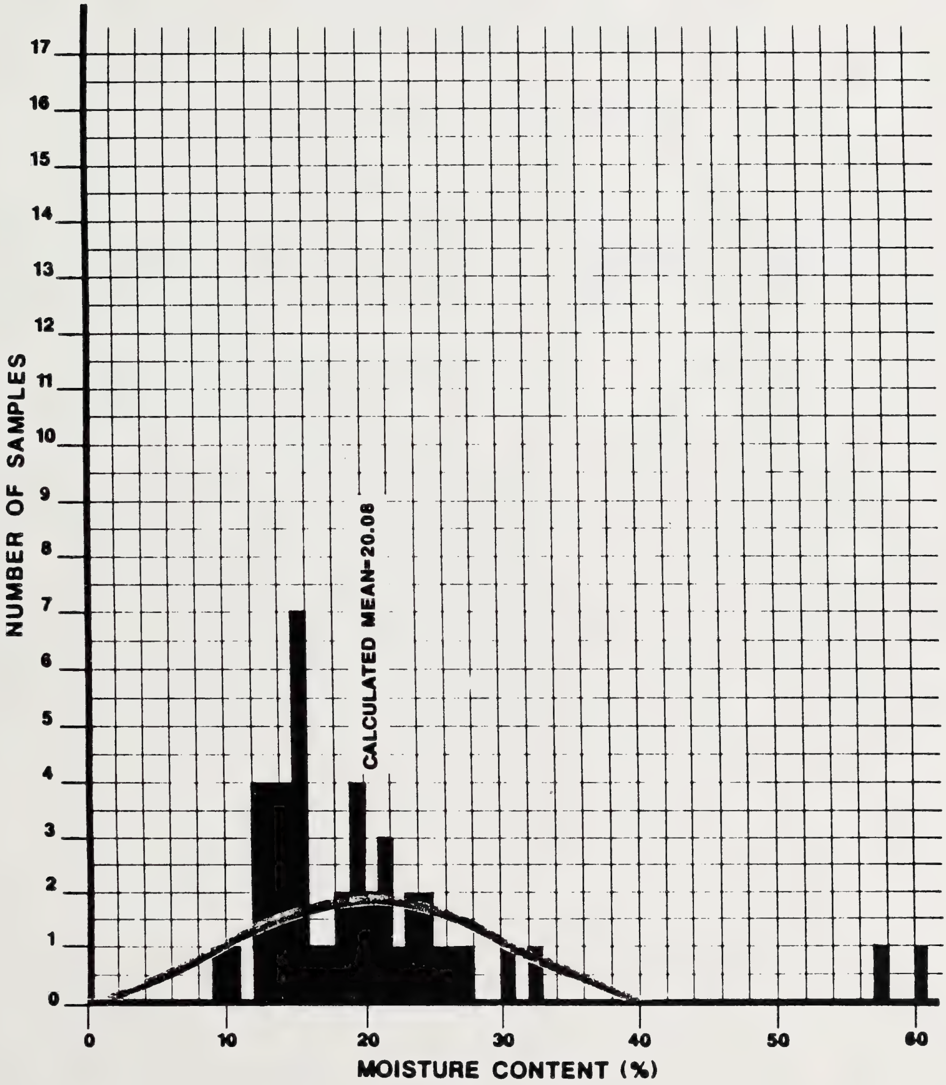
EXTERIOR STUD
3" ABOVE BASE PLATE
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES =146



EXTERIOR STUD
BASE PLATE

COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 46



Appendix D Wood Samples

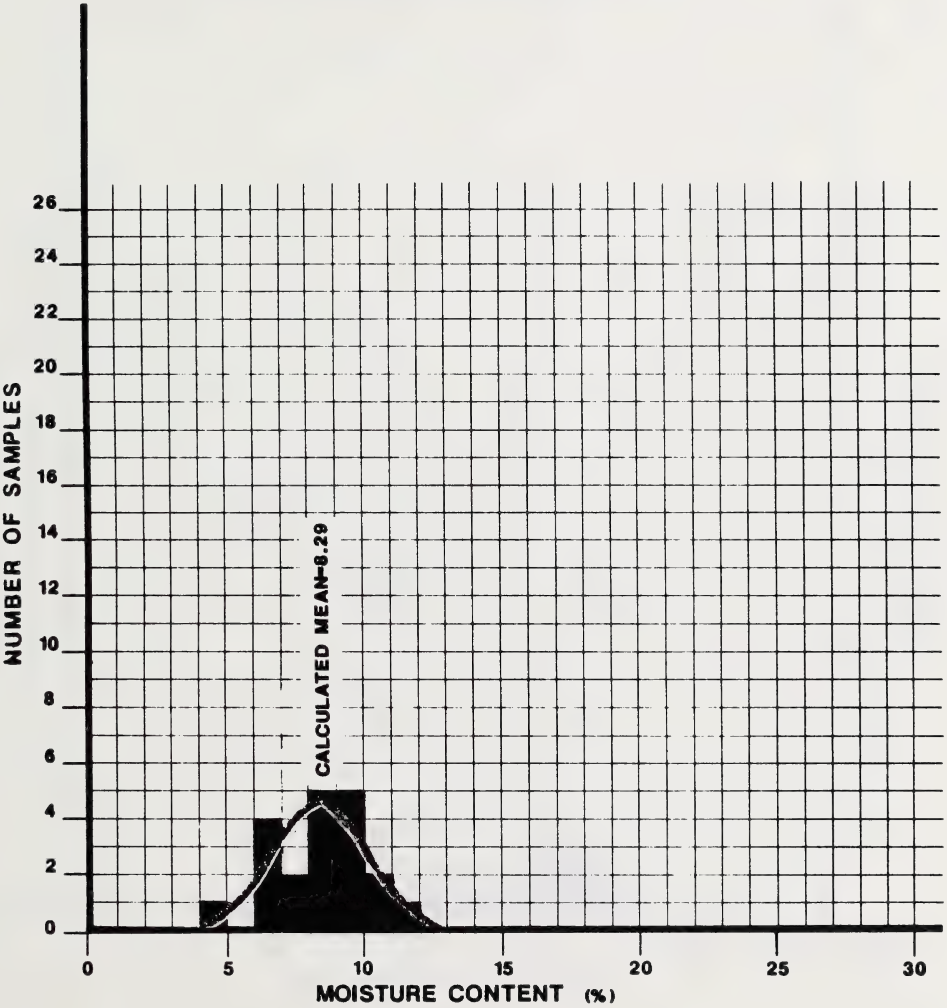
Part IV Moisture Contents with Positive Backfill Drainage

The plots on pages D22 to D32 are normal distribution plots of the moisture contents taken where the exterior drainage is positive, the calculated mean and the best fit normal distribution curve.

FLOOR JOISTS

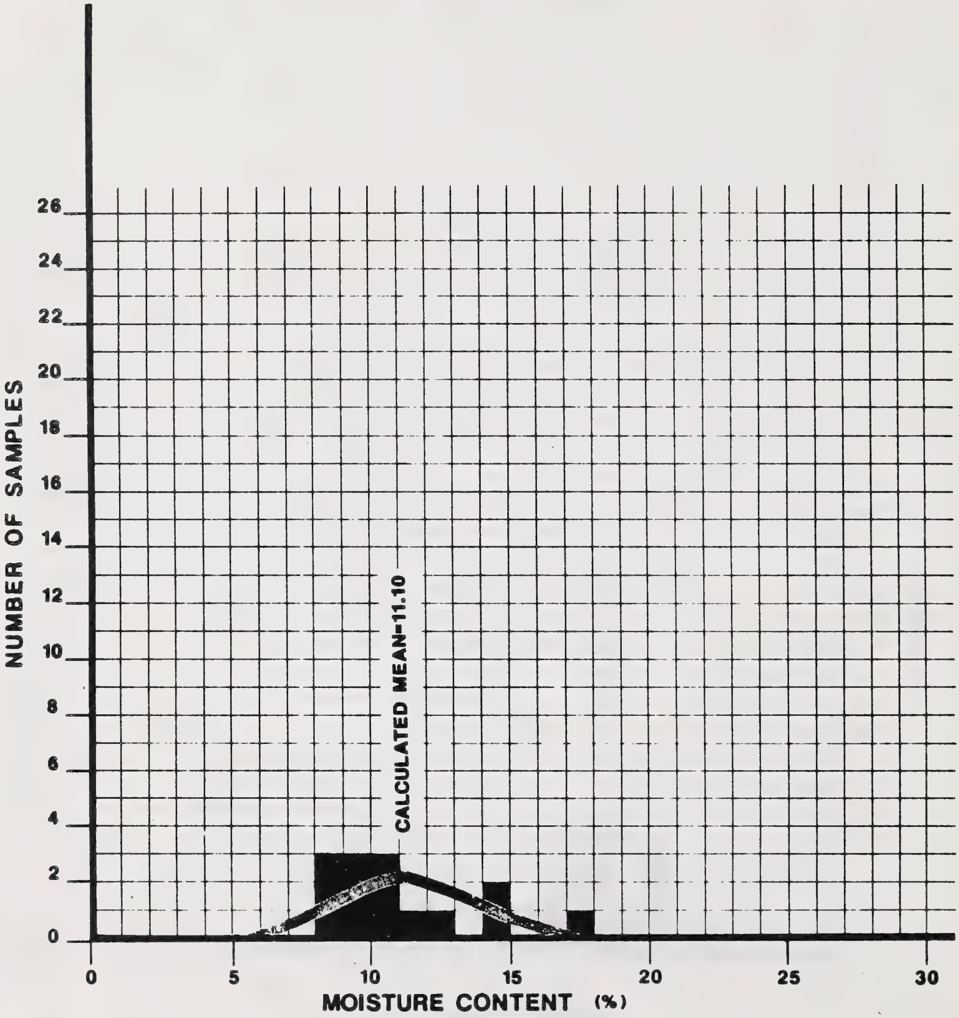
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 20



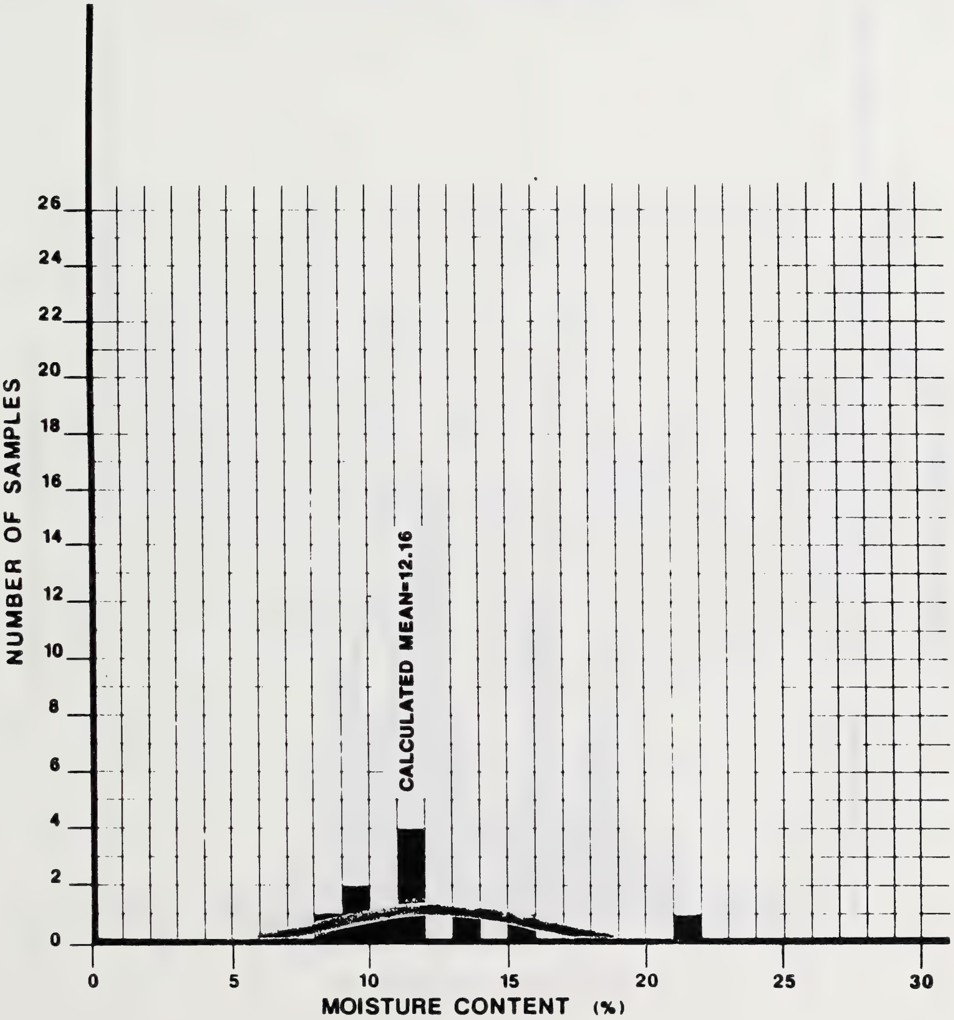
INTERIOR STUD
3" ABOVE BASE PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 14



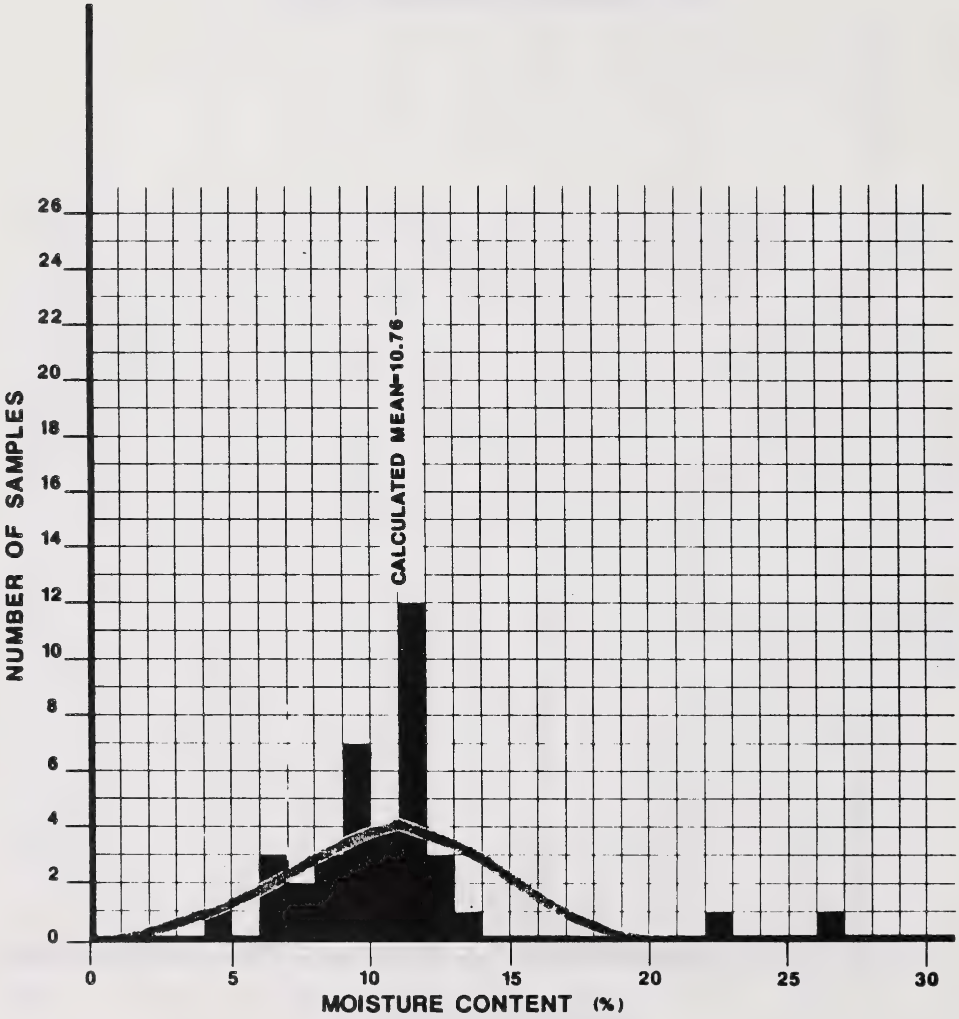
INTERIOR STUD
BASE PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 11



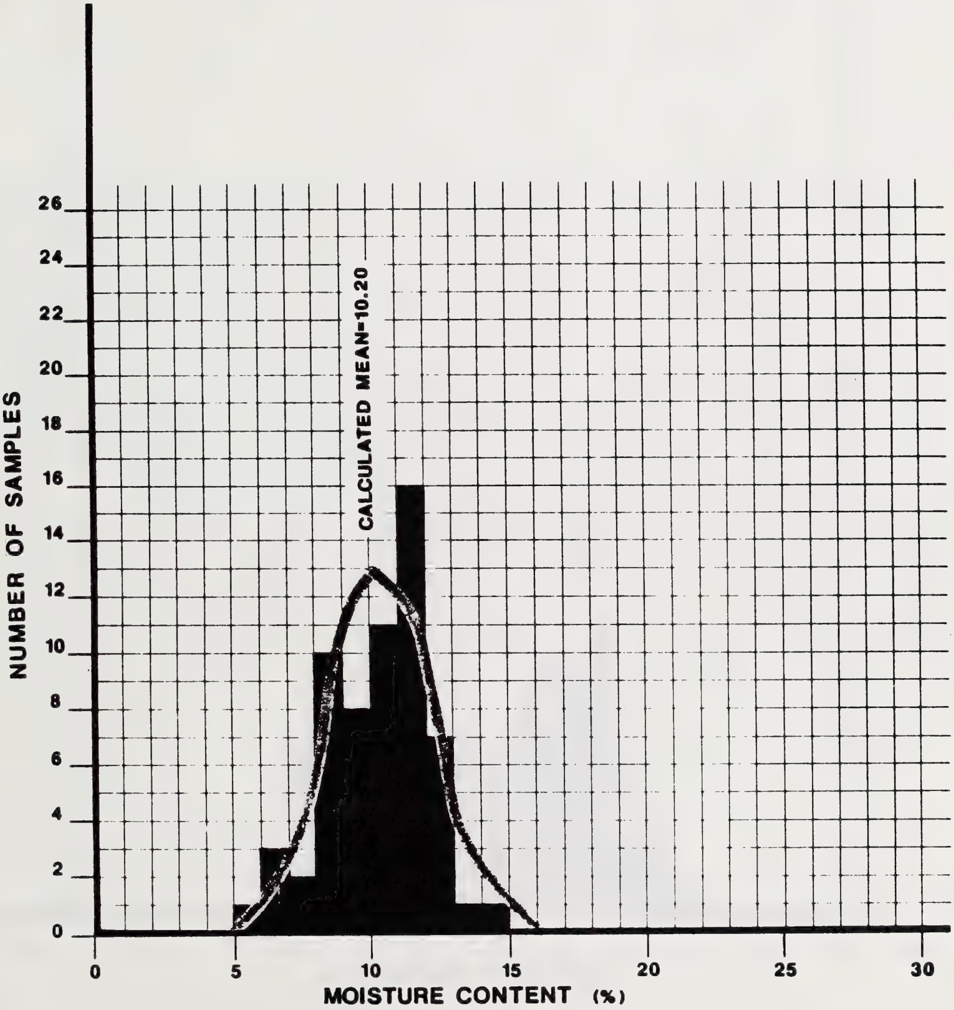
EXTERIOR STUD
TOP PLATE AND CAP PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 38



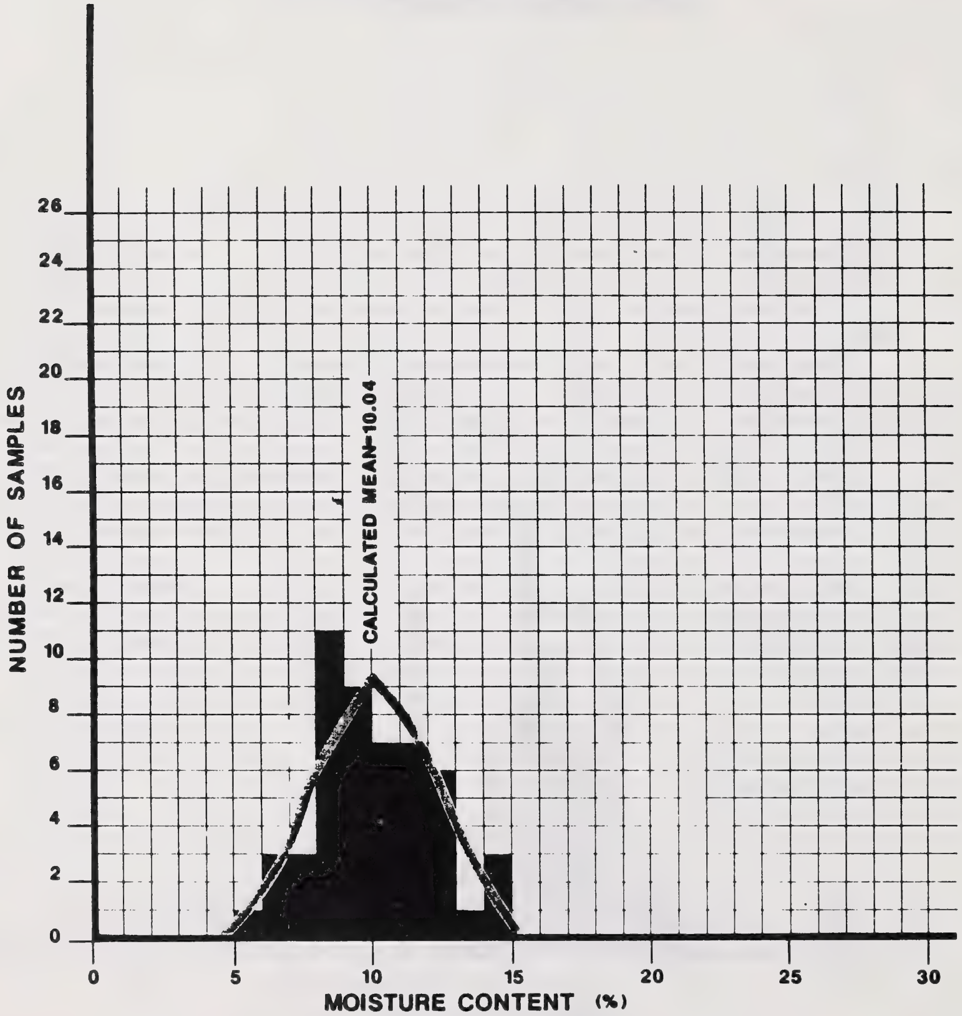
EXTERIOR STUD
3" BELOW TOP PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



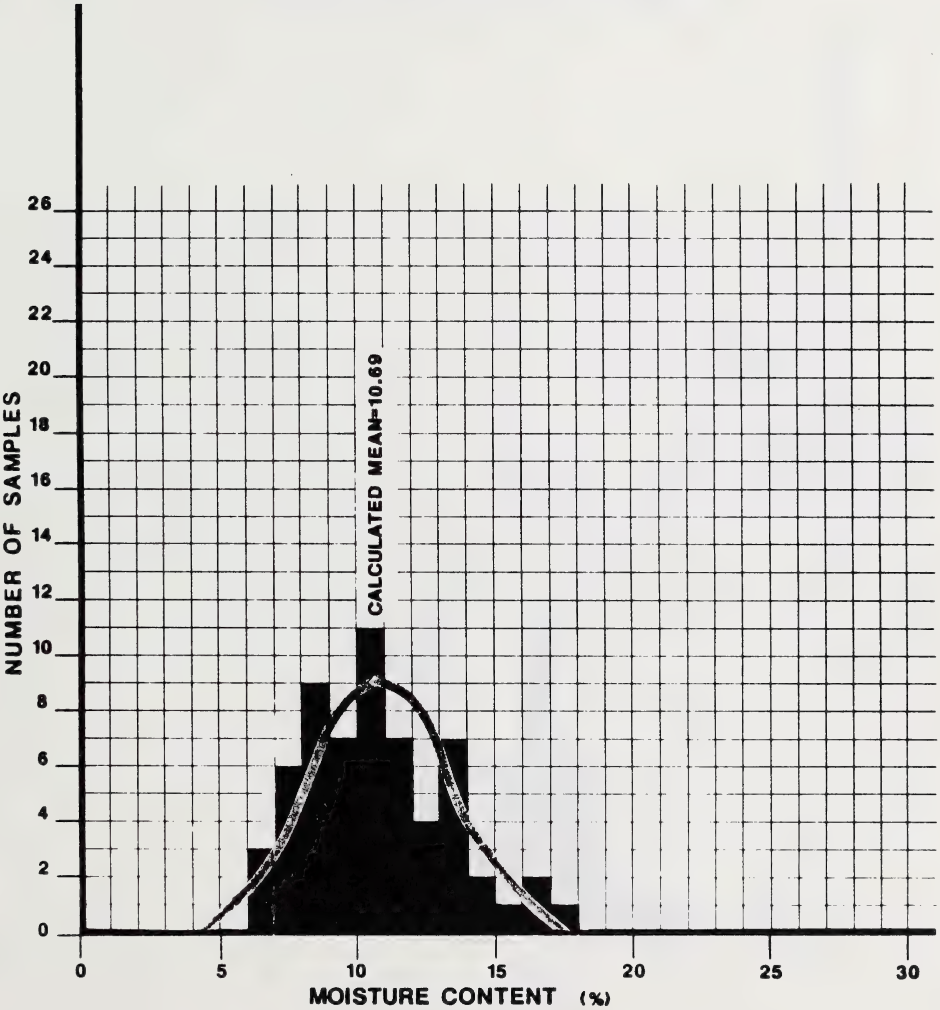
EXTERIOR STUD
12" ABOVE GRADE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 51



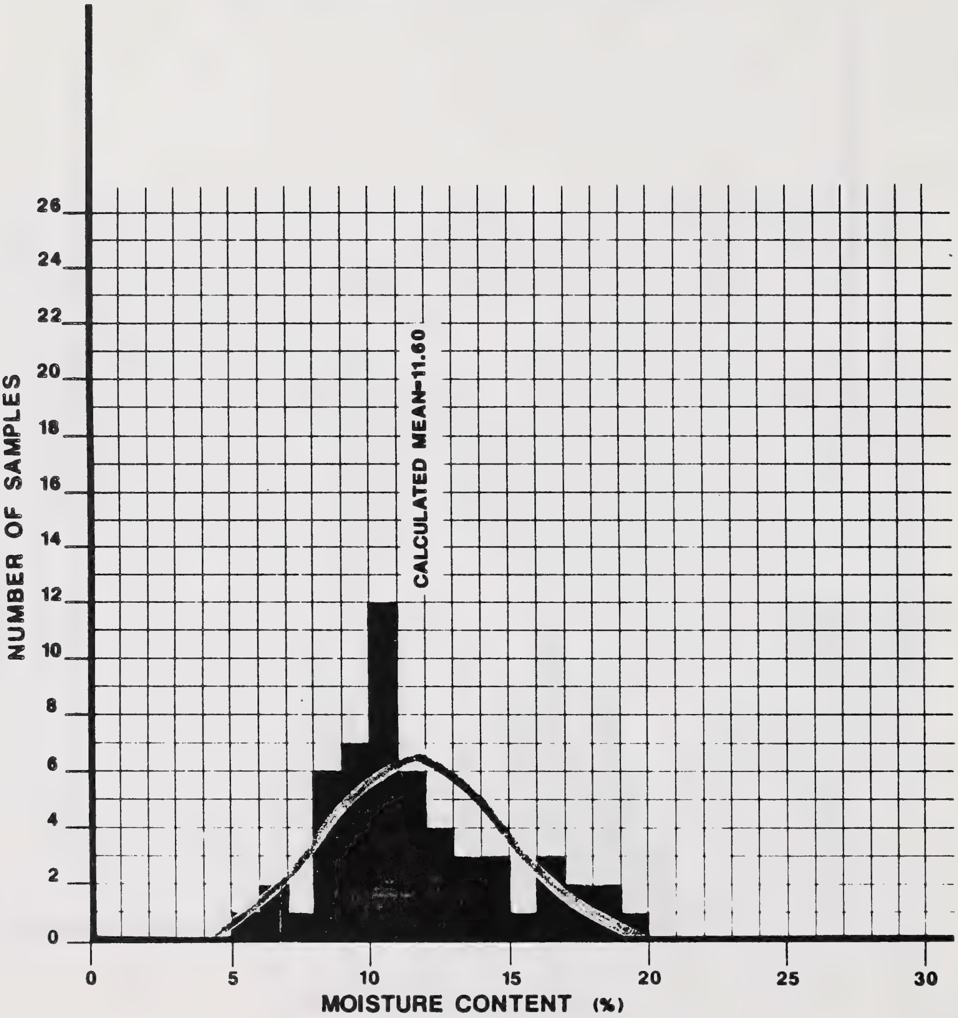
EXTERIOR STUD
TOP OF GRADE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



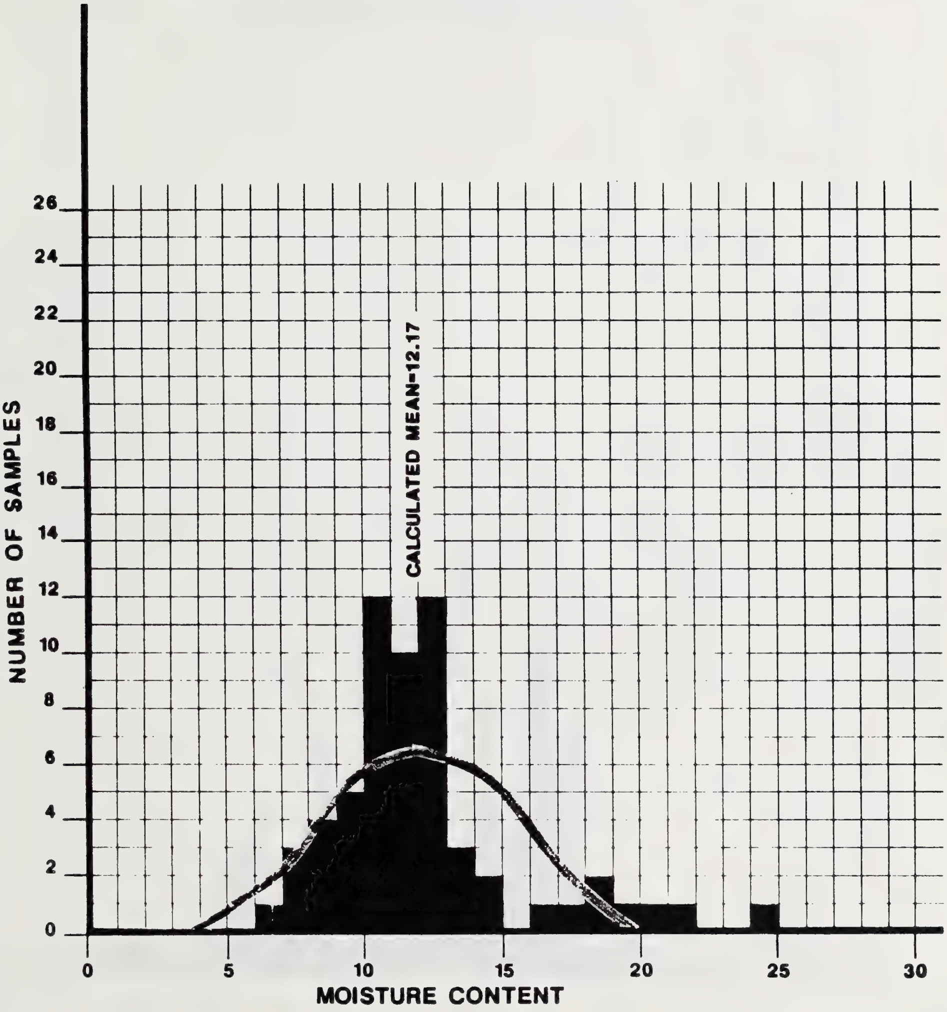
EXTERIOR STUD
12" BELOW GRADE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 54



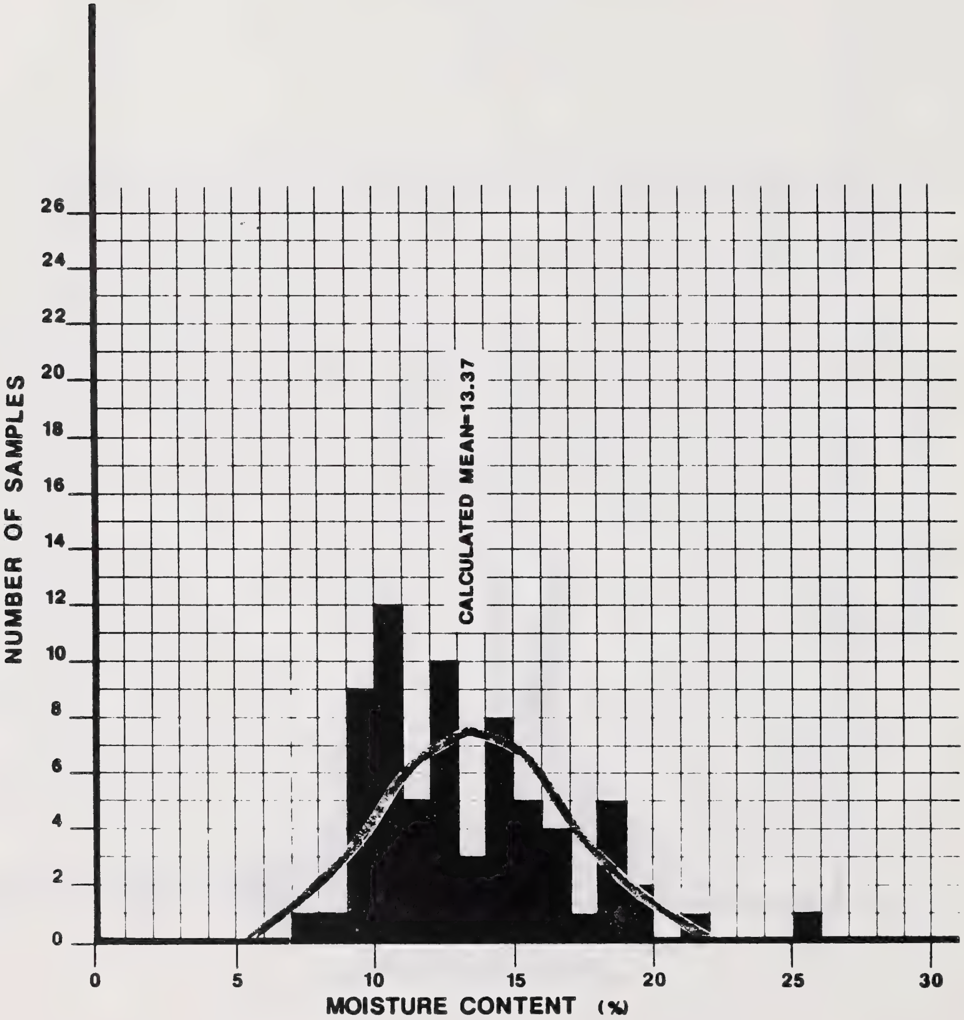
EXTERIOR STUD
MID HEIGHT OF BACKFILL
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



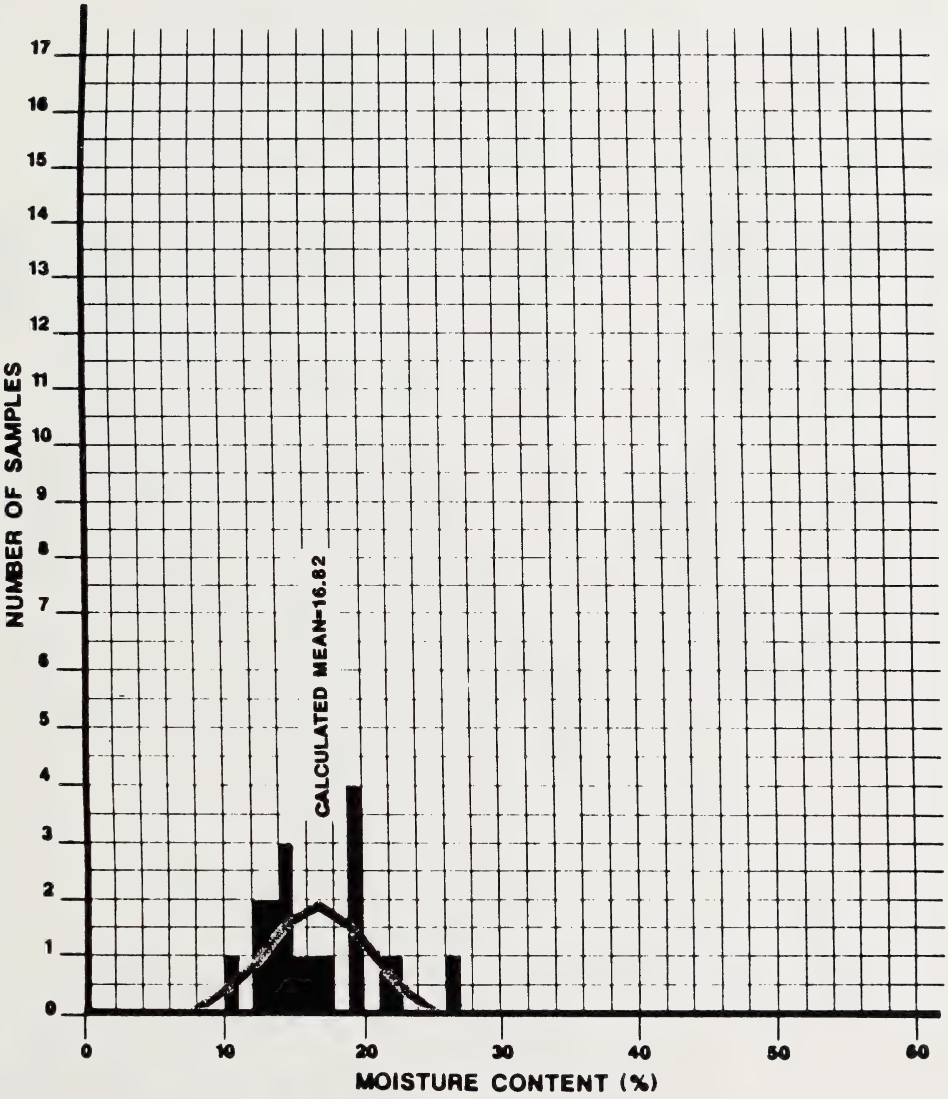
EXTERIOR STUD
3" ABOVE BASE PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 66



EXTERIOR STUD
BASE PLATE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 18



Appendix D Wood Samples

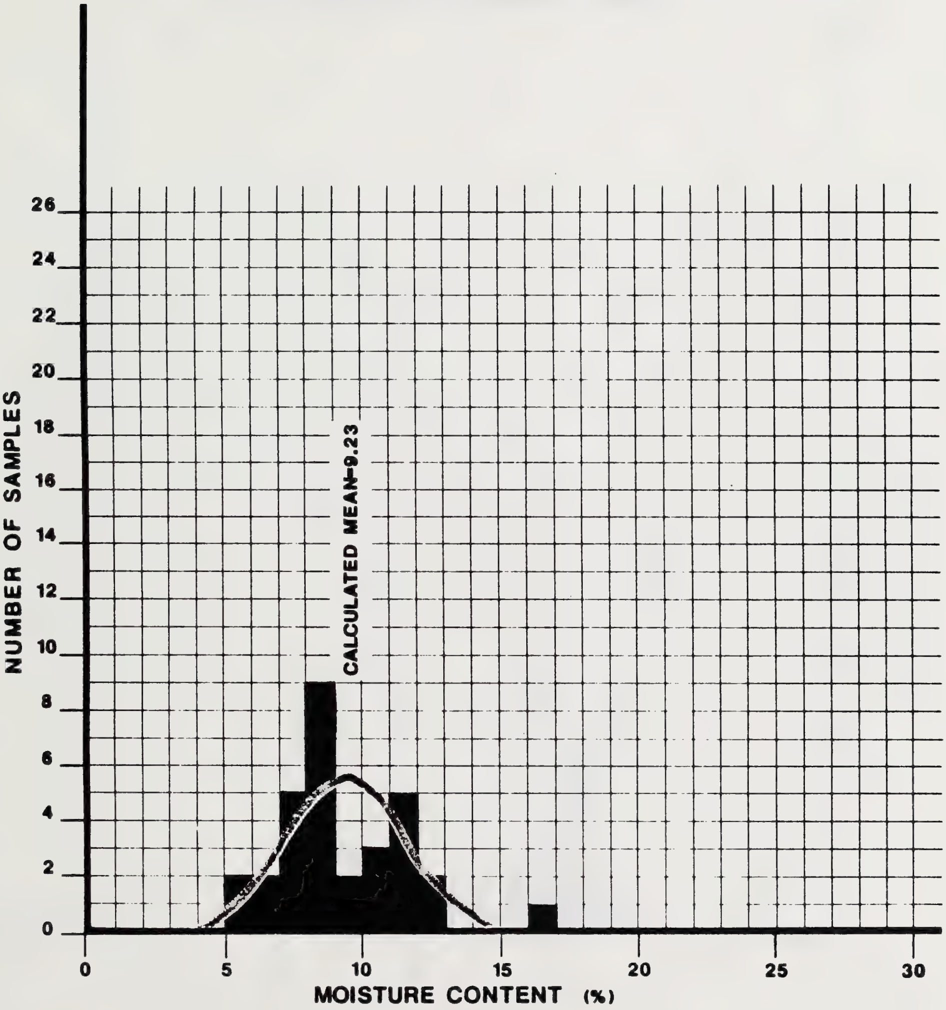
Part V Moisture Contents With Negative Backfill Drainage

The plots on pages D34 to D44 are normal distribution plots of the moisture contents taken where the exterior drainage is negative, the calculated mean and the best fit normal distribution curve.

FLOOR JOISTS

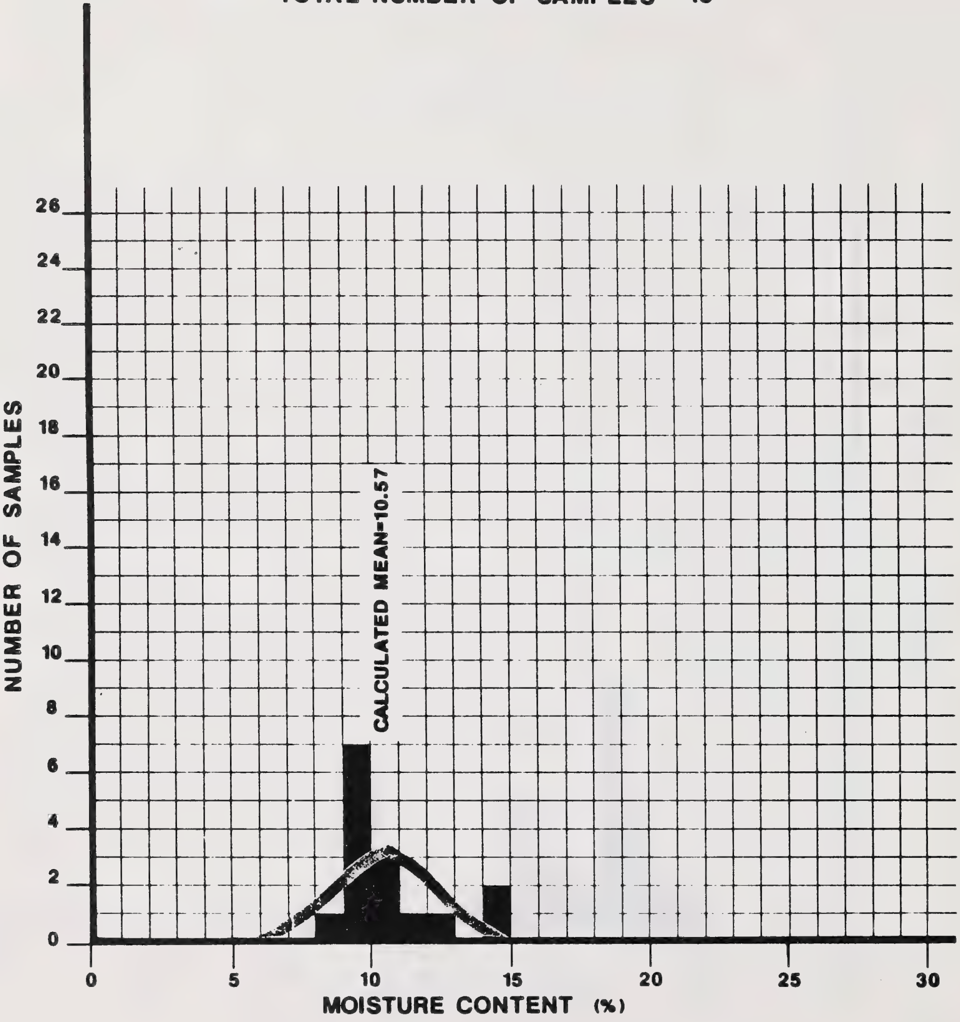
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 31



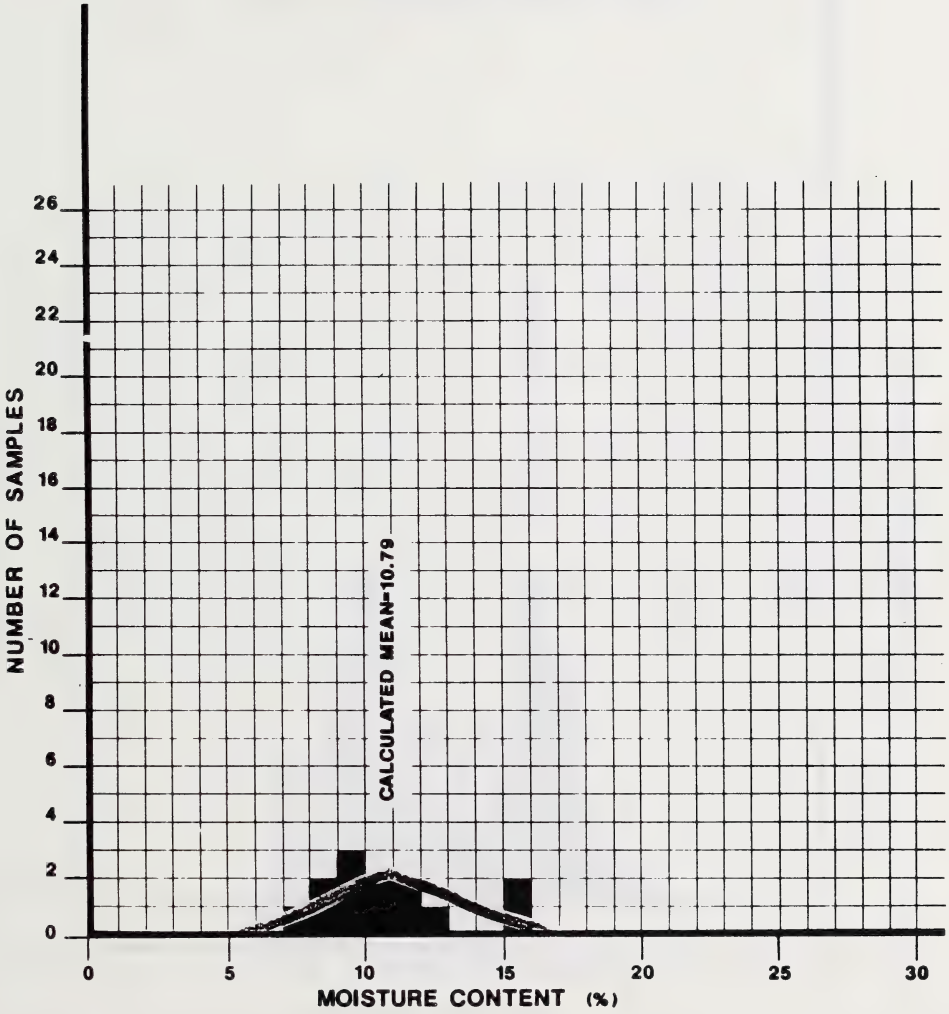
INTERIOR STUD
3" ABOVE BASE PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 15



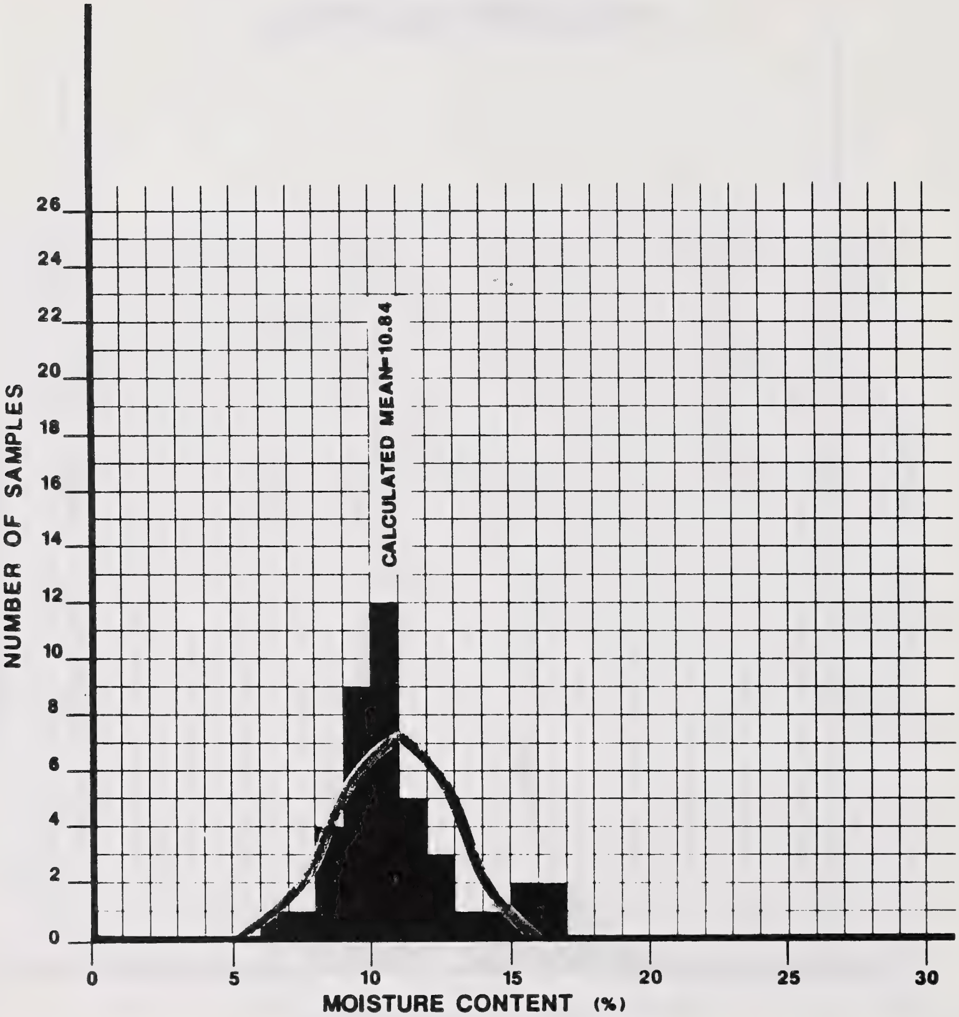
INTERIOR STUD
BASE PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES =13



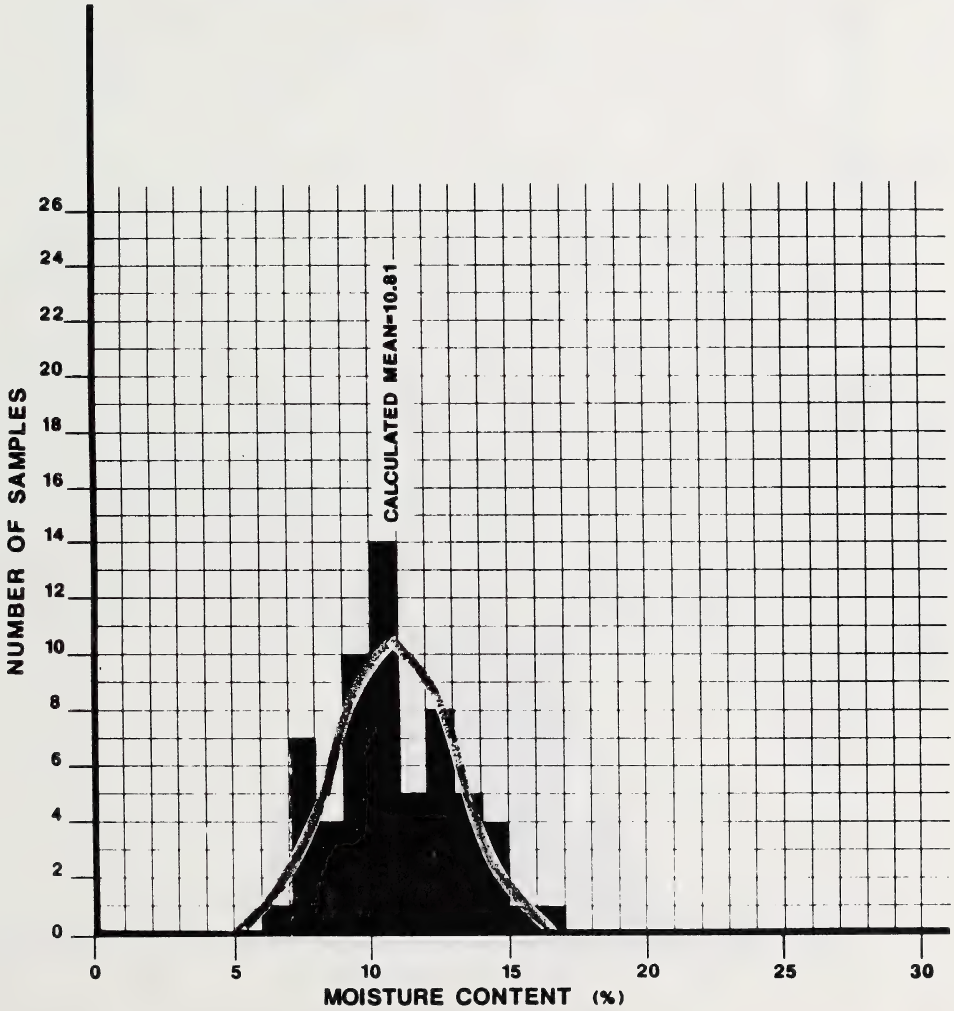
EXTERIOR STUD
TOP PLATE AND CAP PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 41



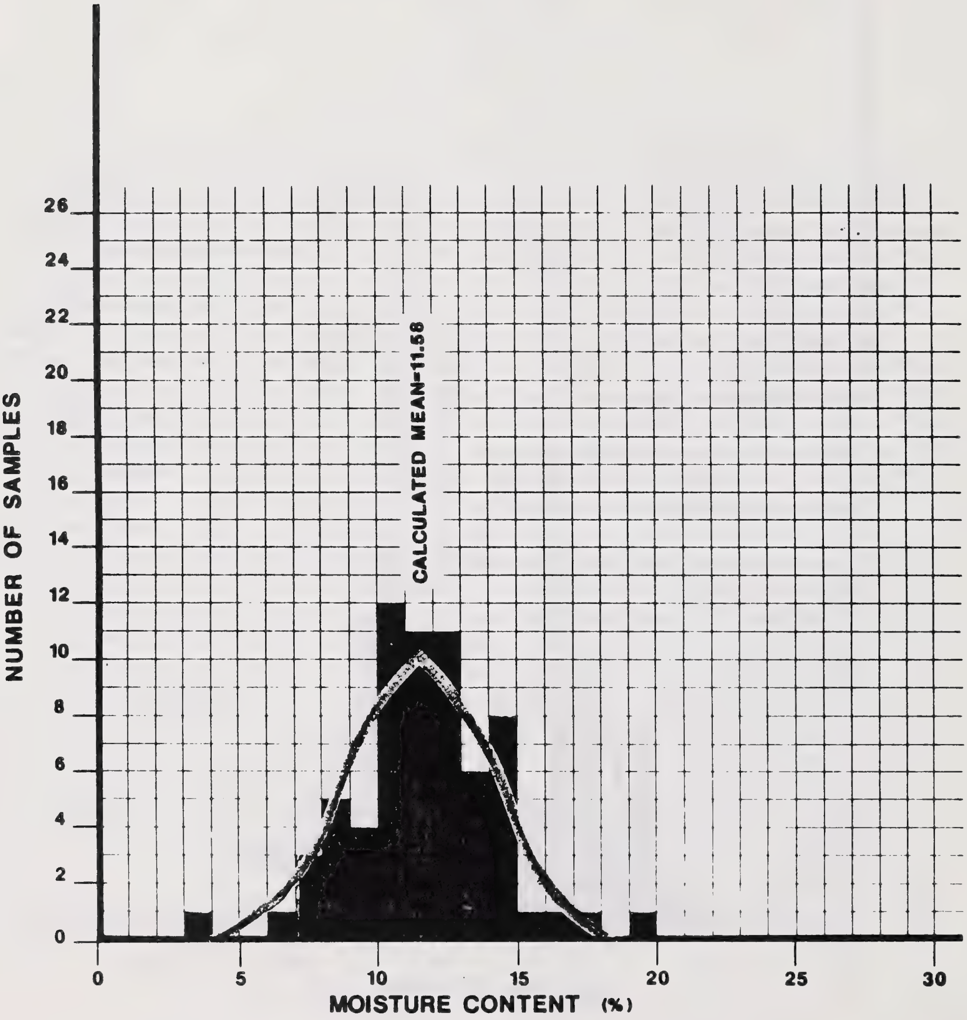
EXTERIOR STUD
3" BELOW TOP PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



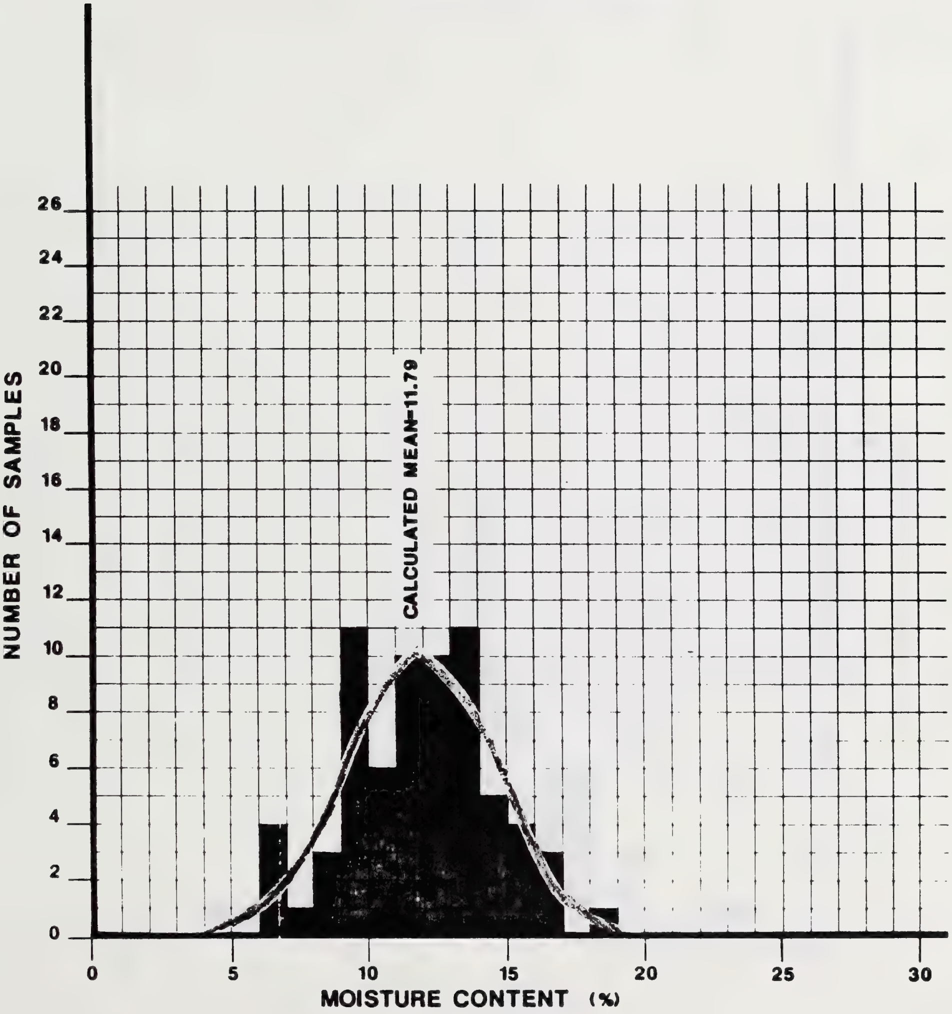
EXTERIOR STUD
12" ABOVE GRADE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 66



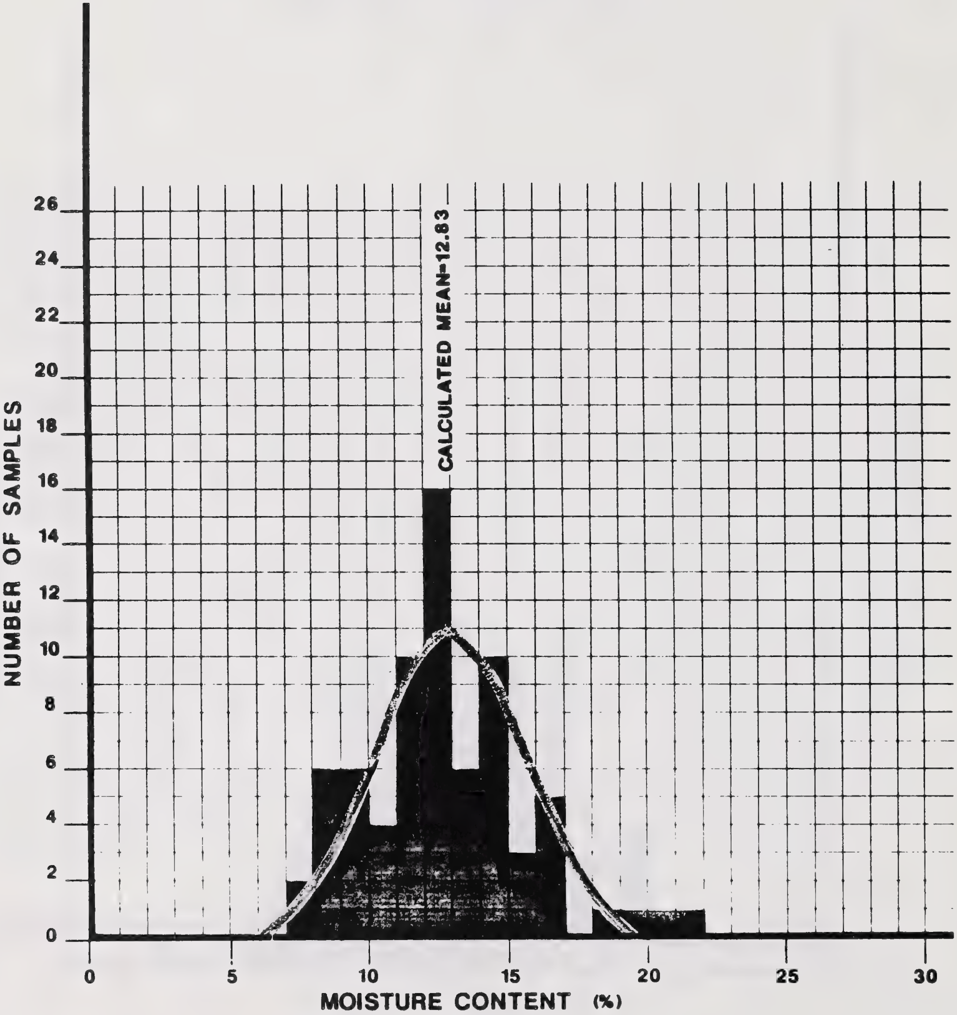
EXTERIOR STUD
TOP OF GRADE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 69



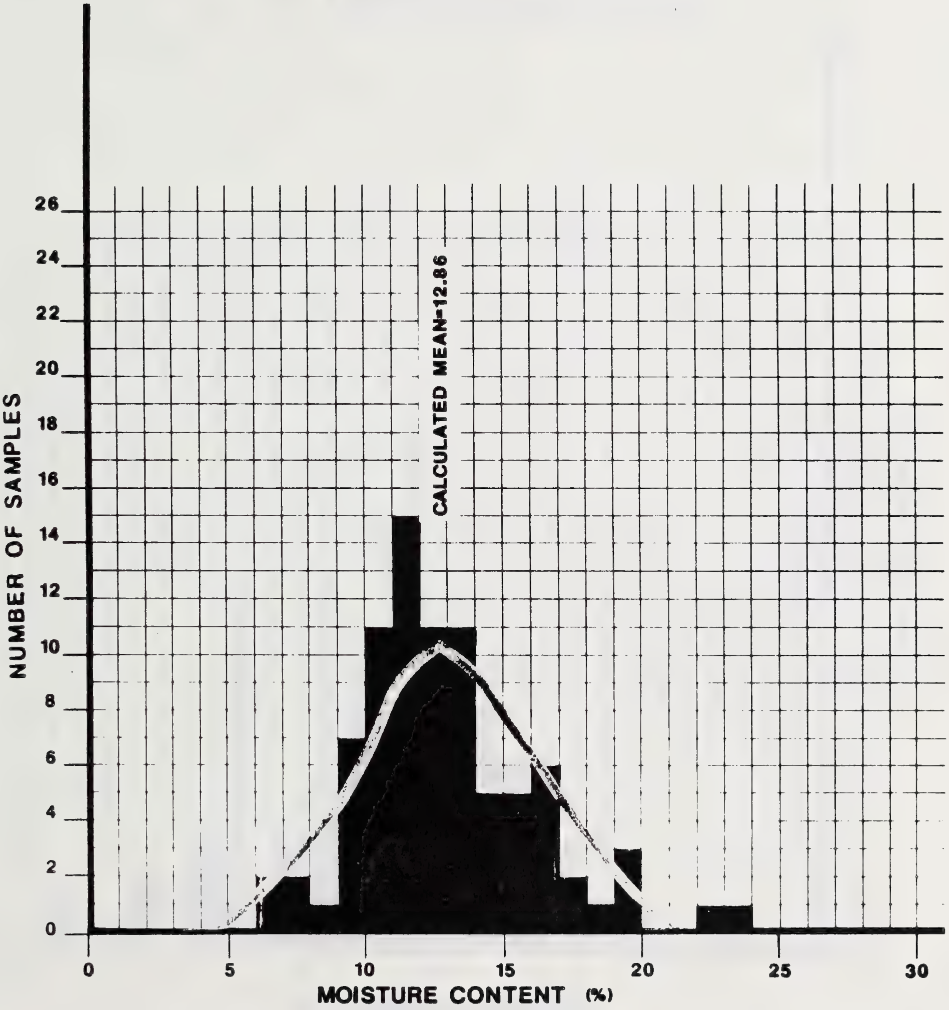
EXTERIOR STUD
12" BELOW GRADE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 72



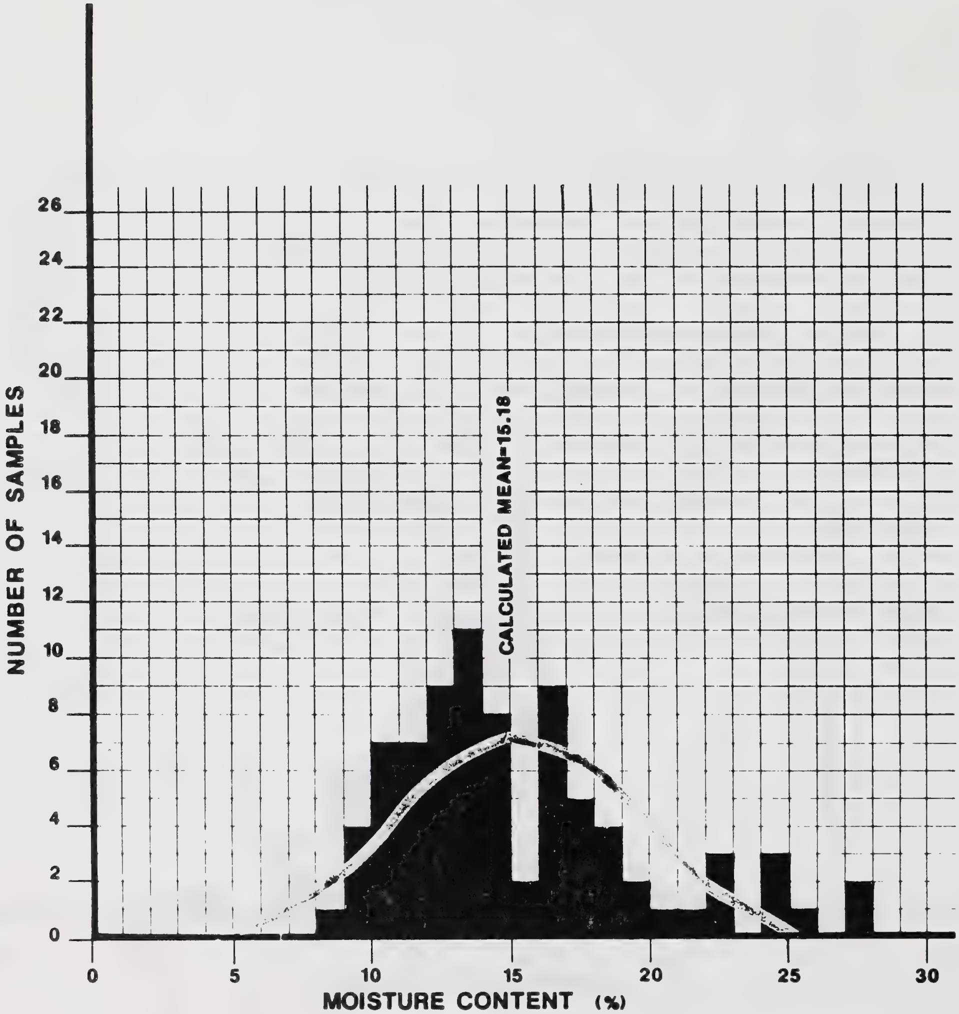
EXTERIOR STUD
MID HEIGHT OF BACKFILL
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 84



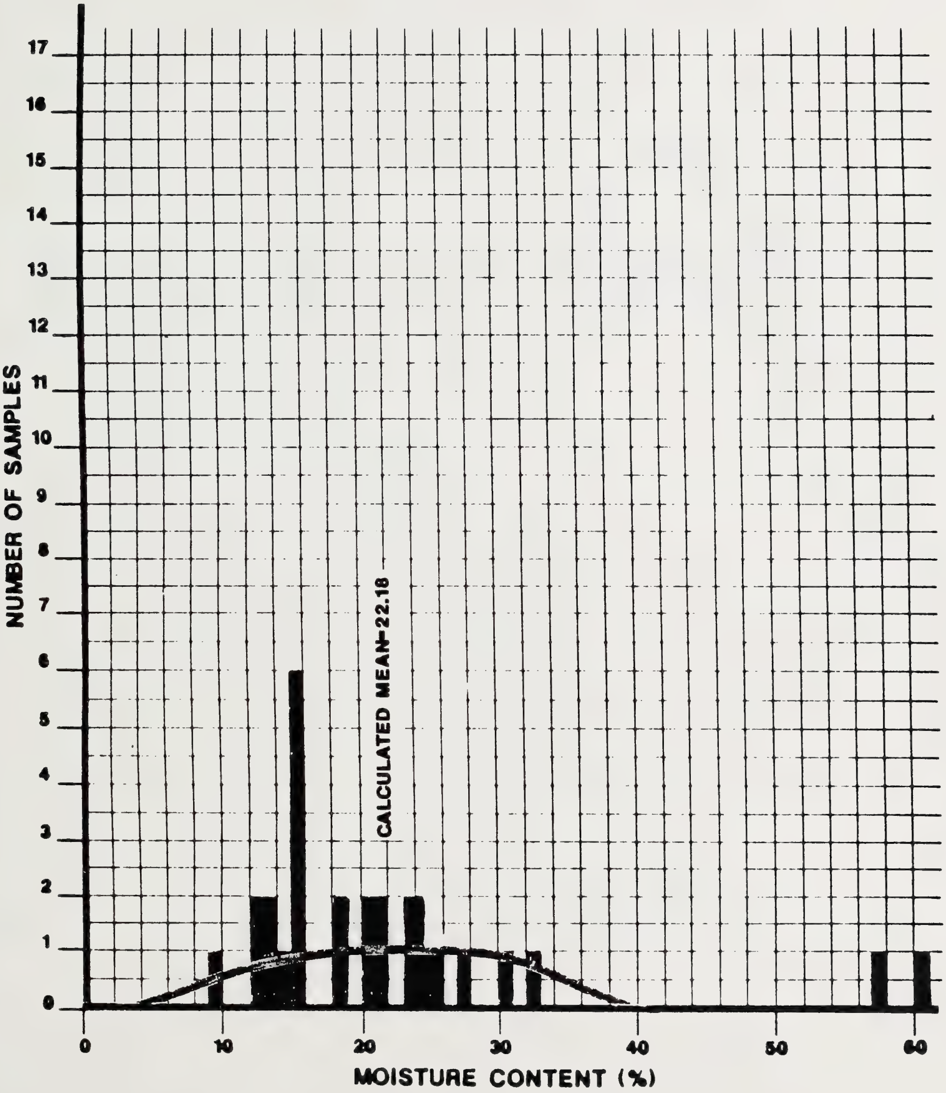
EXTERIOR STUD
3" ABOVE BASE PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 80



EXTERIOR STUD
BASE PLATE
NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 28

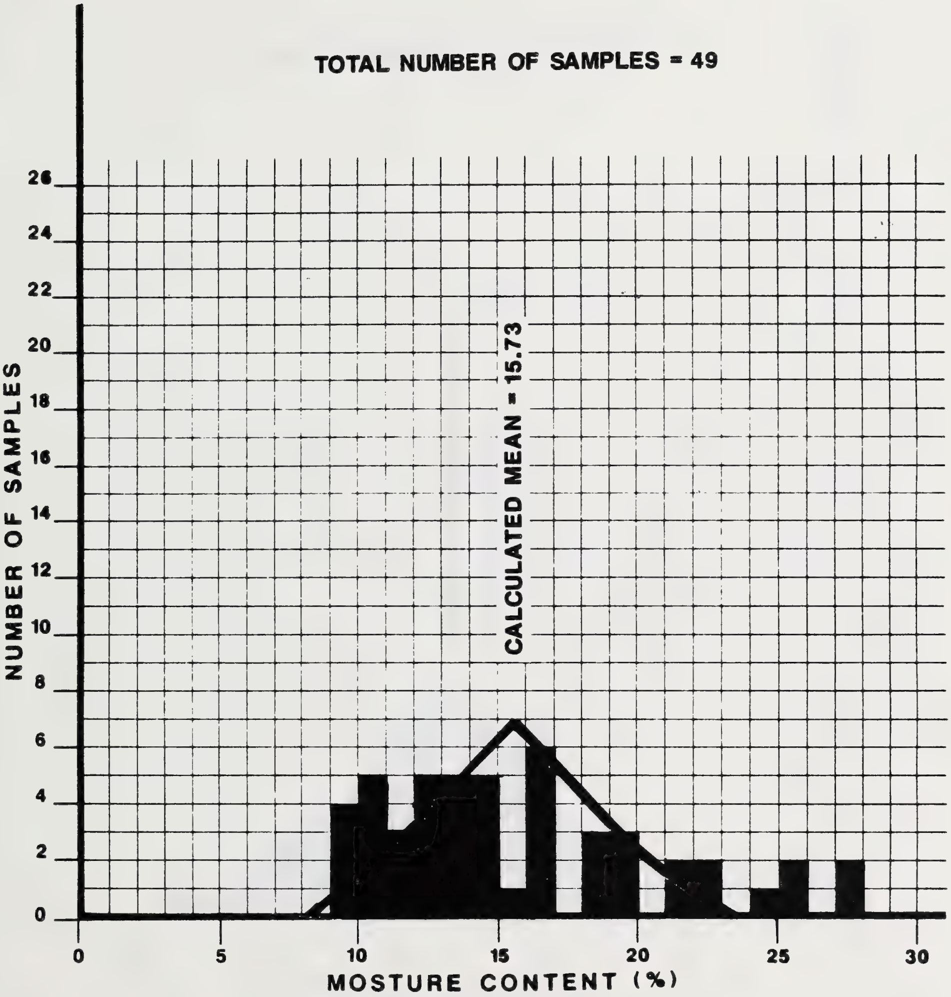


Appendix D Wood Samples

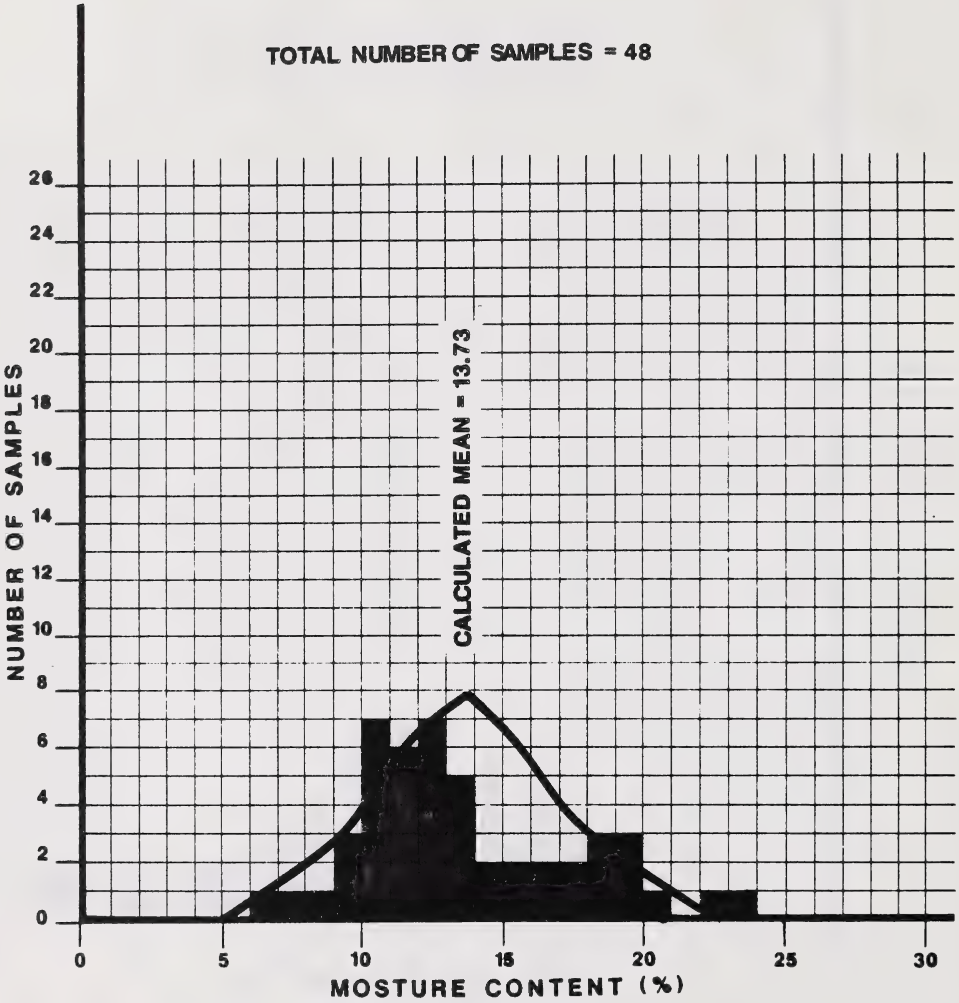
Part VI Moisture Contents at Specified Sampling Points

The plots on pages D46 to D51 are normal distribution plots of the moisture contents in the outer one third of the stud, the calculated mean and the best fit normal distribution curve.

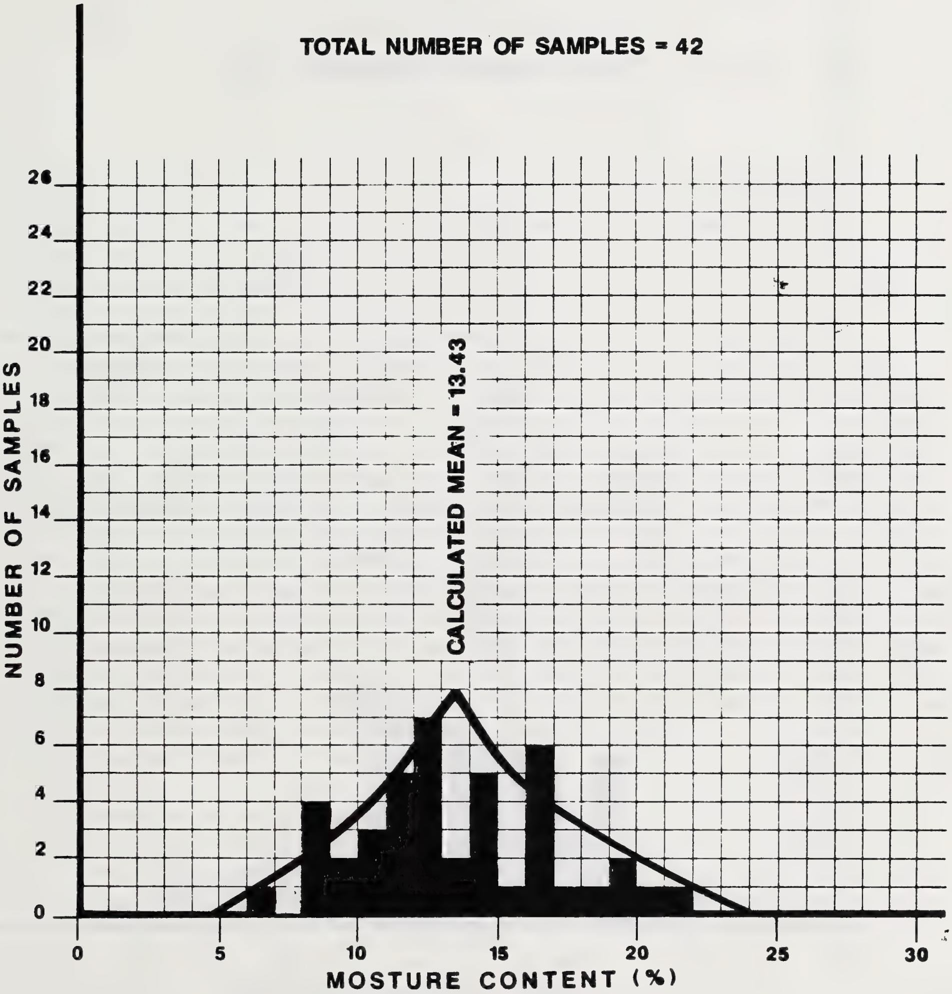
EXTERIOR STUD
3" ABOVE BASE PLATE
OUTER 1/3"



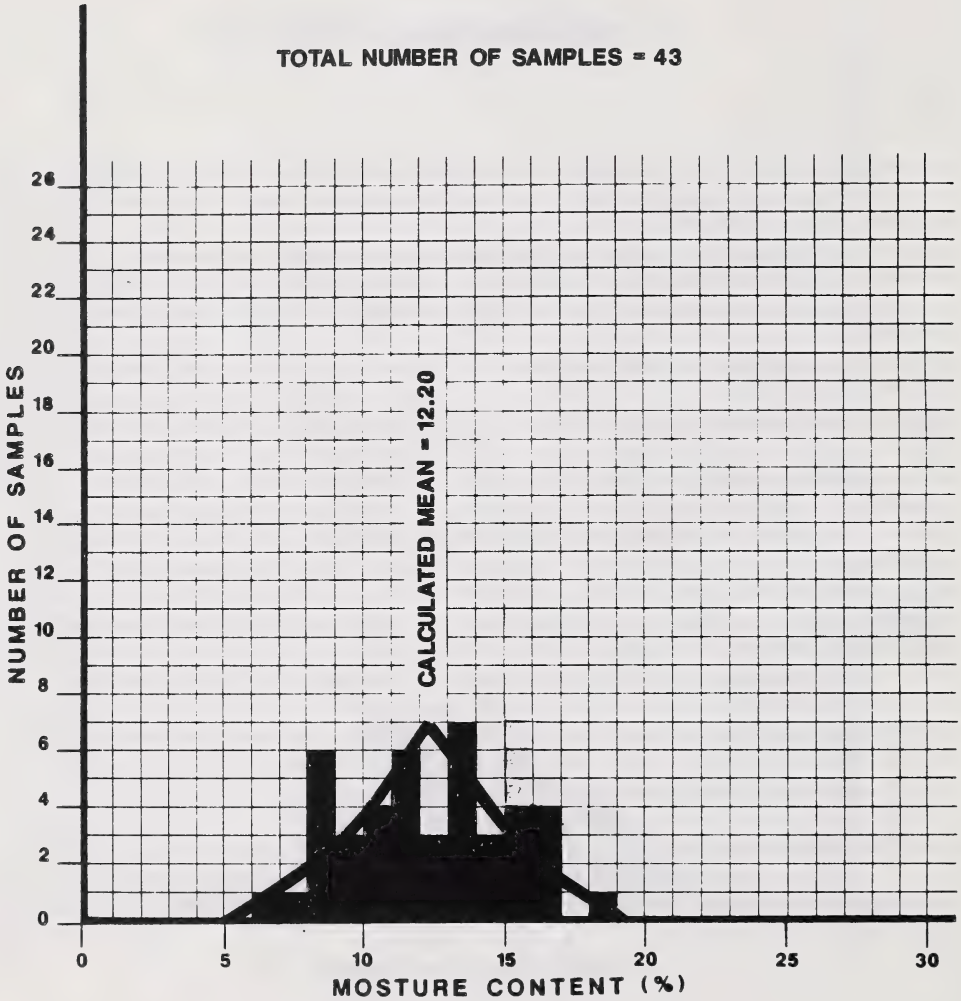
EXTERIOR STUD
MID HEIGHT OF BACKFILL
OUTER 1/3"



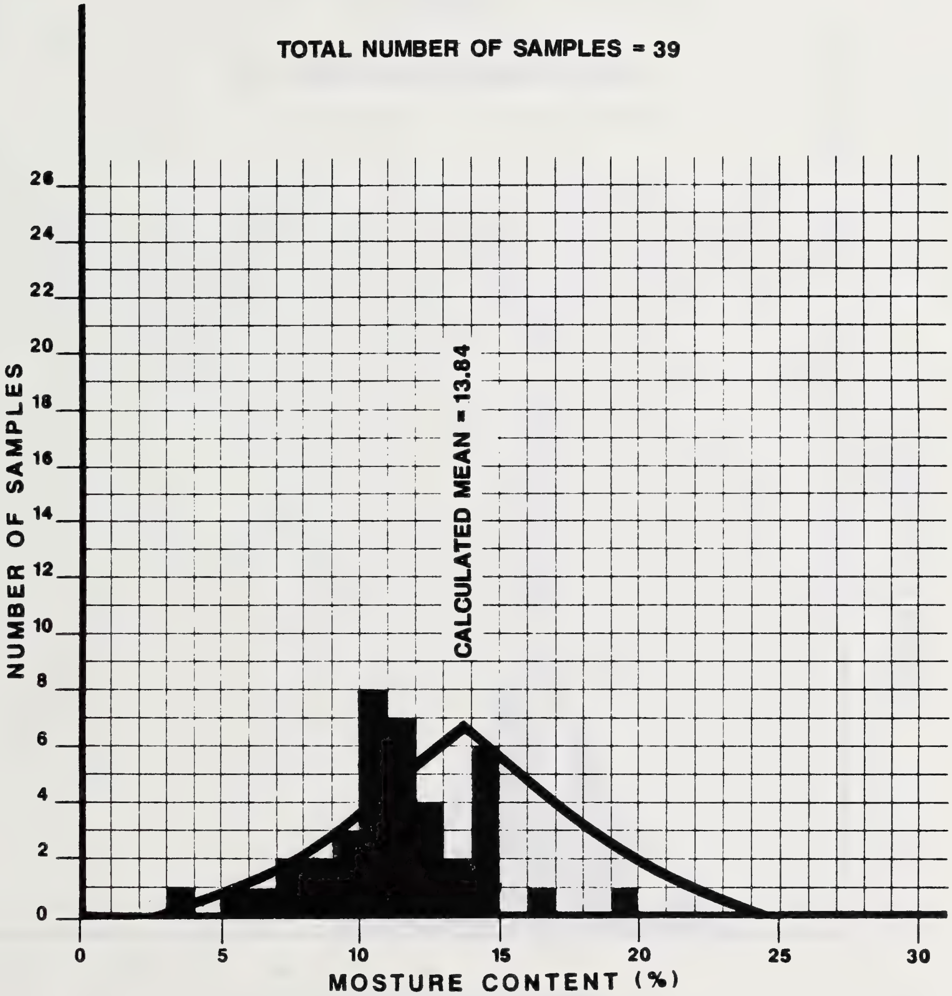
EXTERIOR STUD
12" BELOW GRADE
OUTER 1/3"



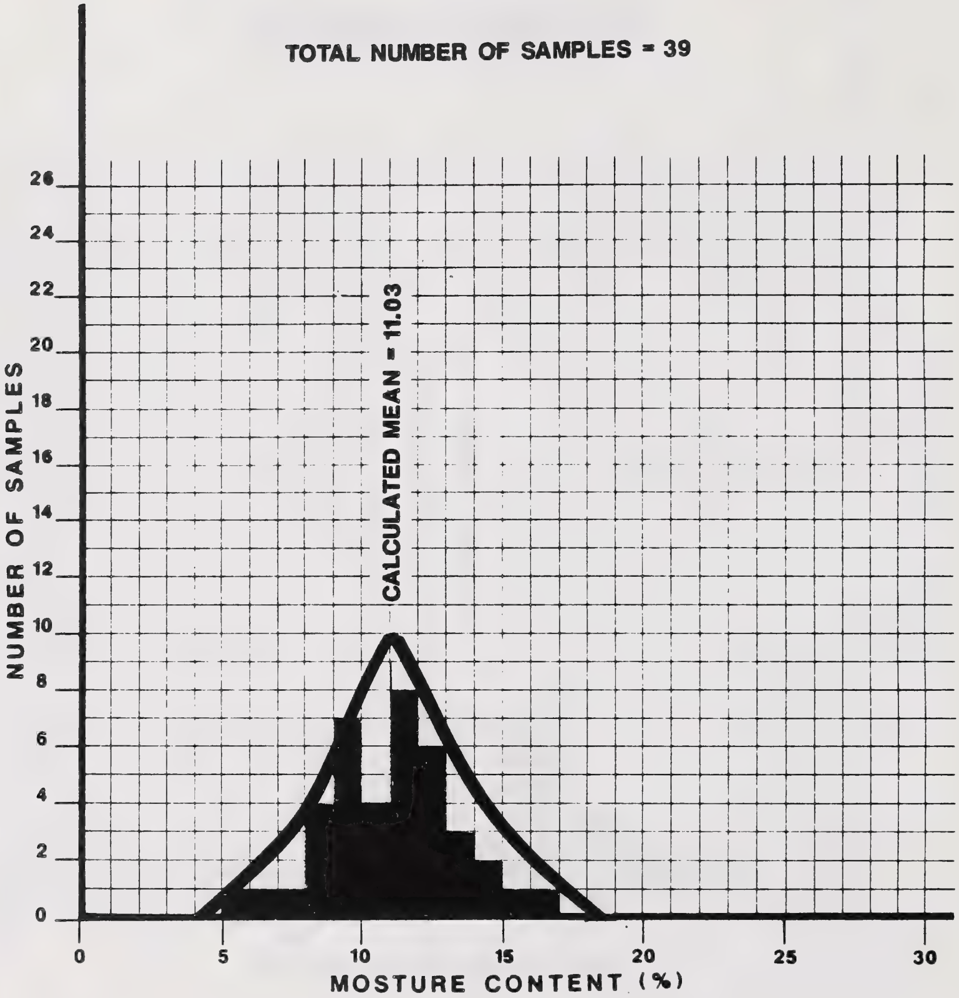
EXTERIOR STUD
TOP OF GRADE
OUTER 1/3"



EXTERIOR STUD
12" ABOVE GRADE
OUTER 1/3"



EXTERIOR STUD
3" BELOW TOP PLATE
OUTER 1/3"

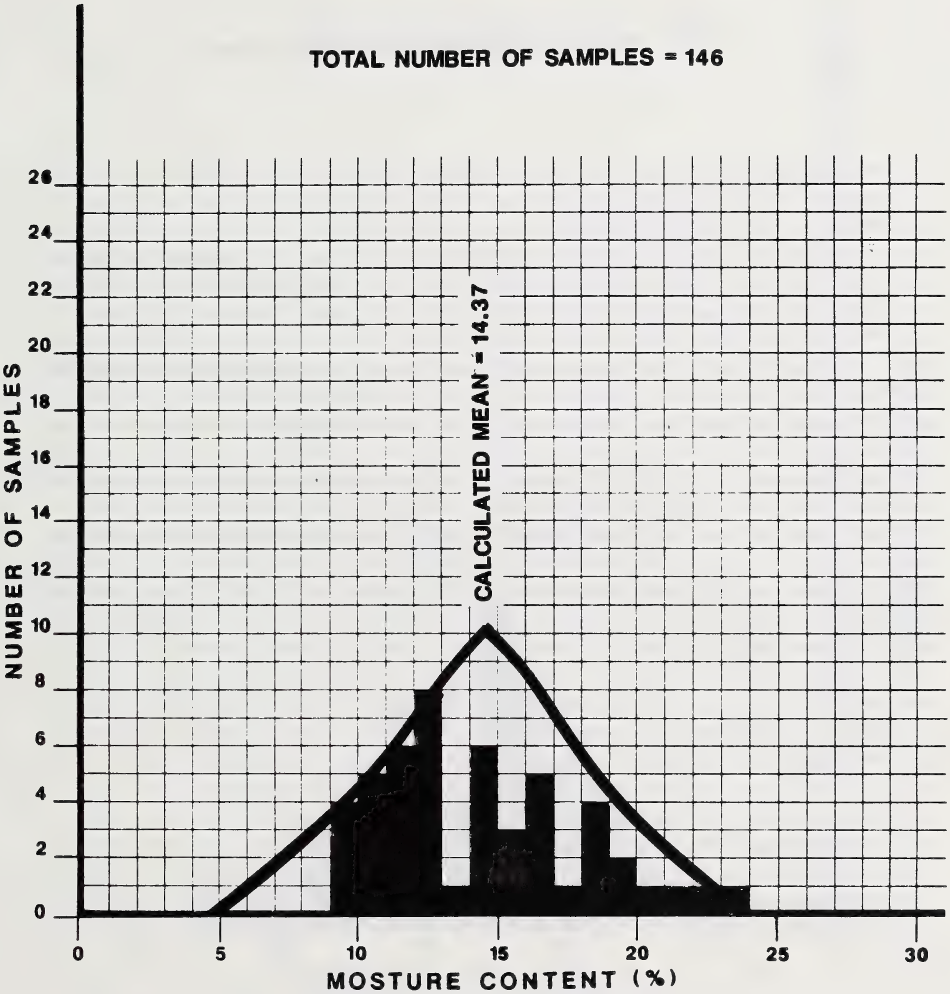


Appendix D Wood Samples

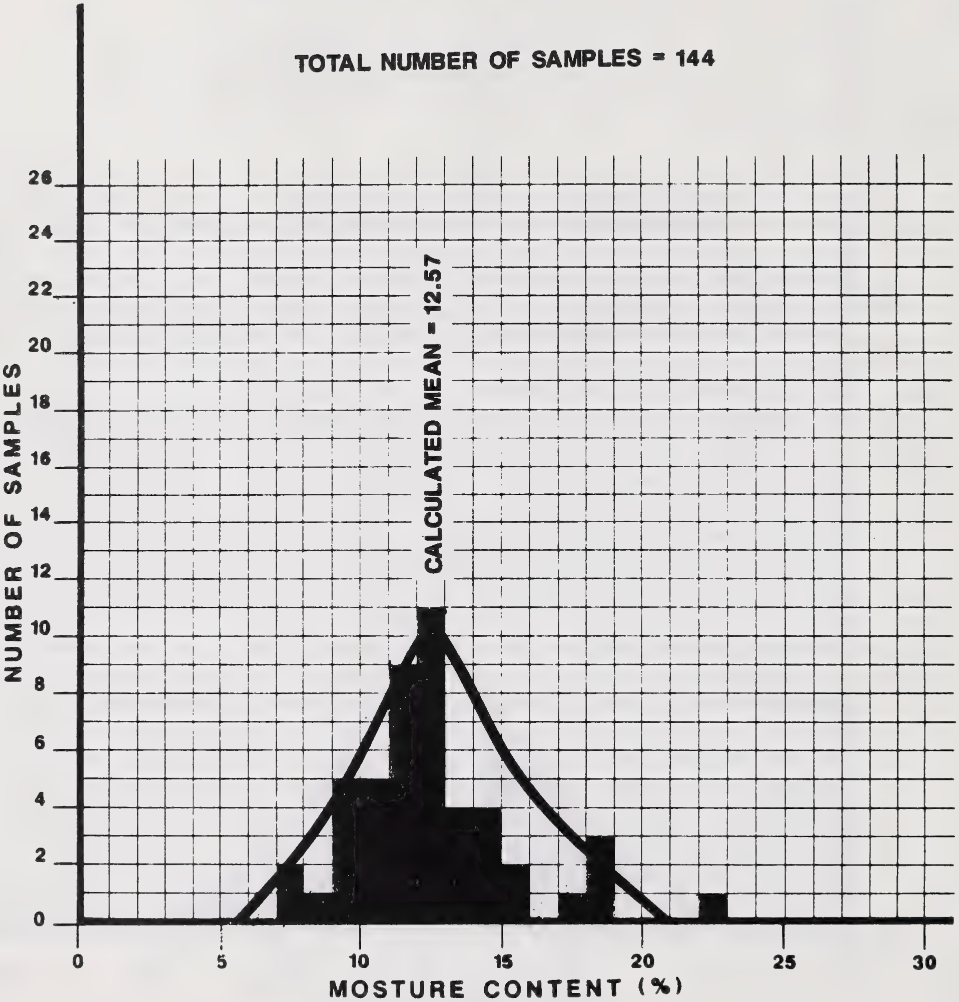
Part VII Mean Moisture Contents at Specified Sampling Points

The plots on pages D53 to D58 are normal distribution plots of the mean moisture contents of the PWF studs at the specified sampling location, the calculated mean and the best fit normal distribution curve.

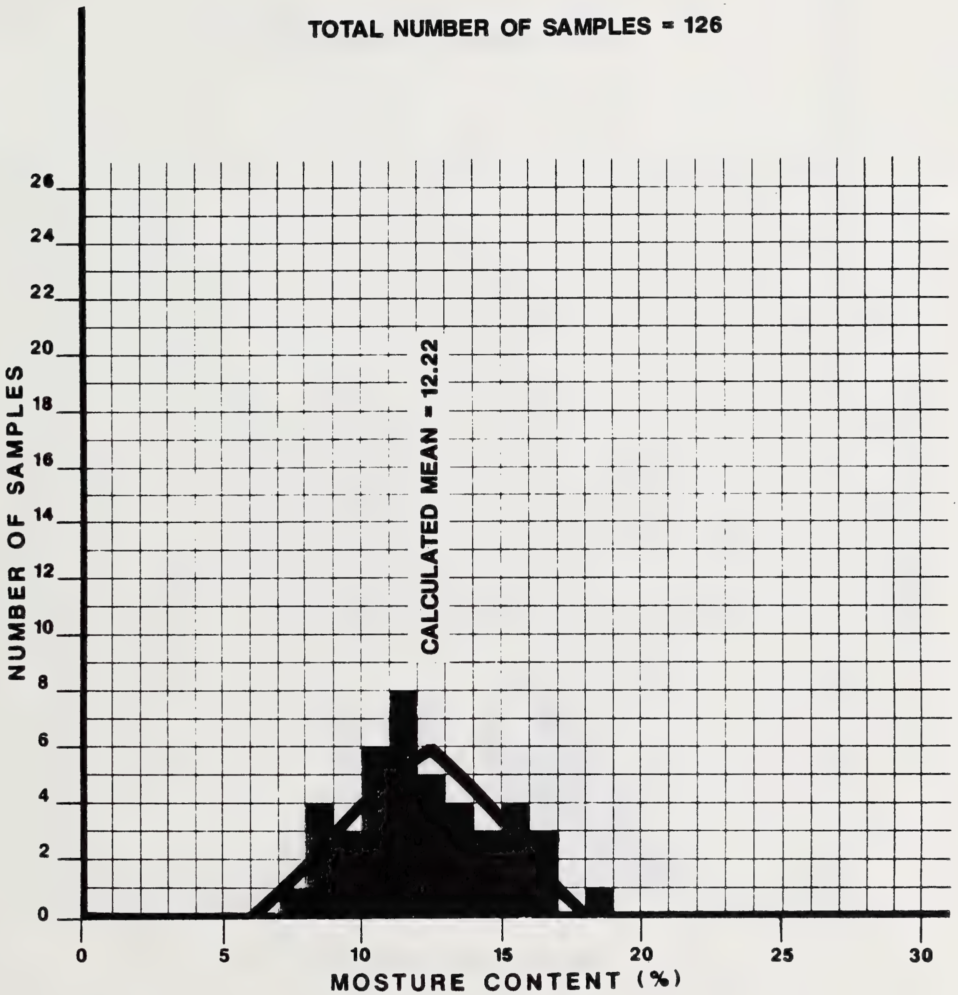
EXTERIOR STUD
3" ABOVE BASE PLATE
AVERAGE VALUE ACROSS STUD



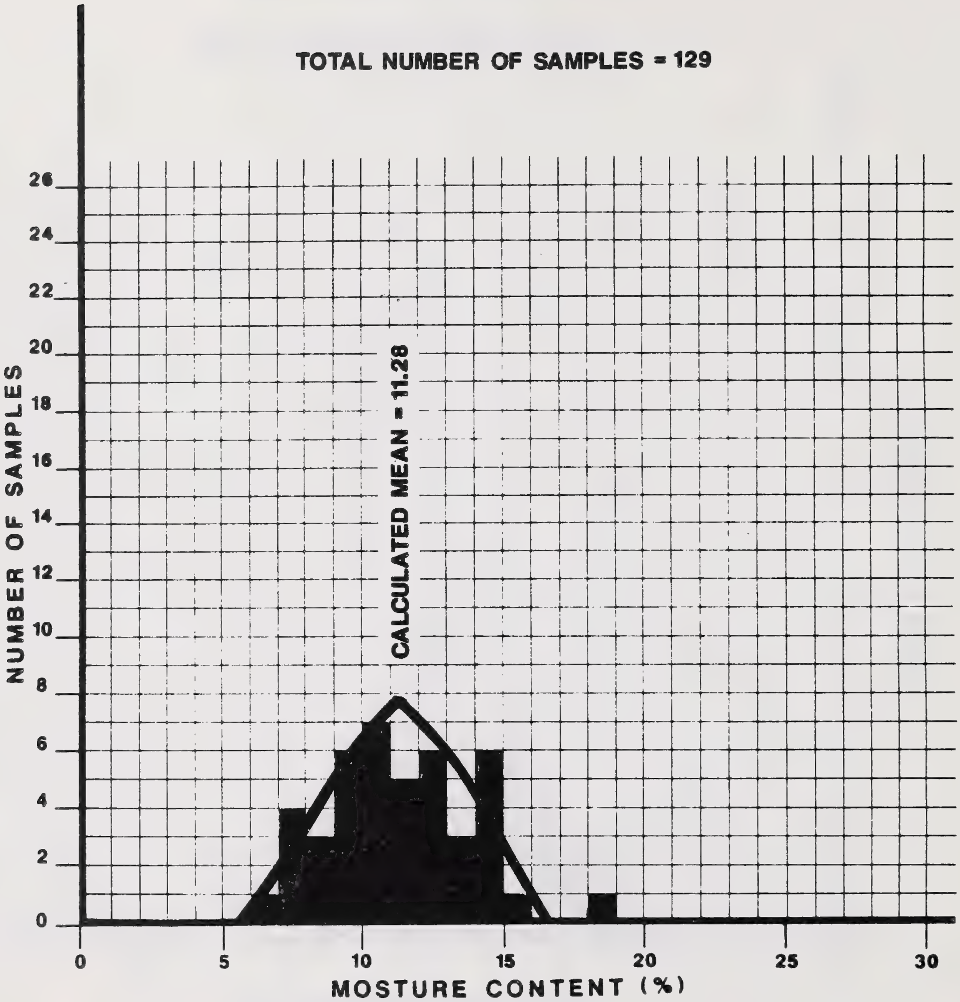
EXTERIOR STUD
MID HEIGHT OF BACKFILL
AVERAGE VALUE ACROSS STUD



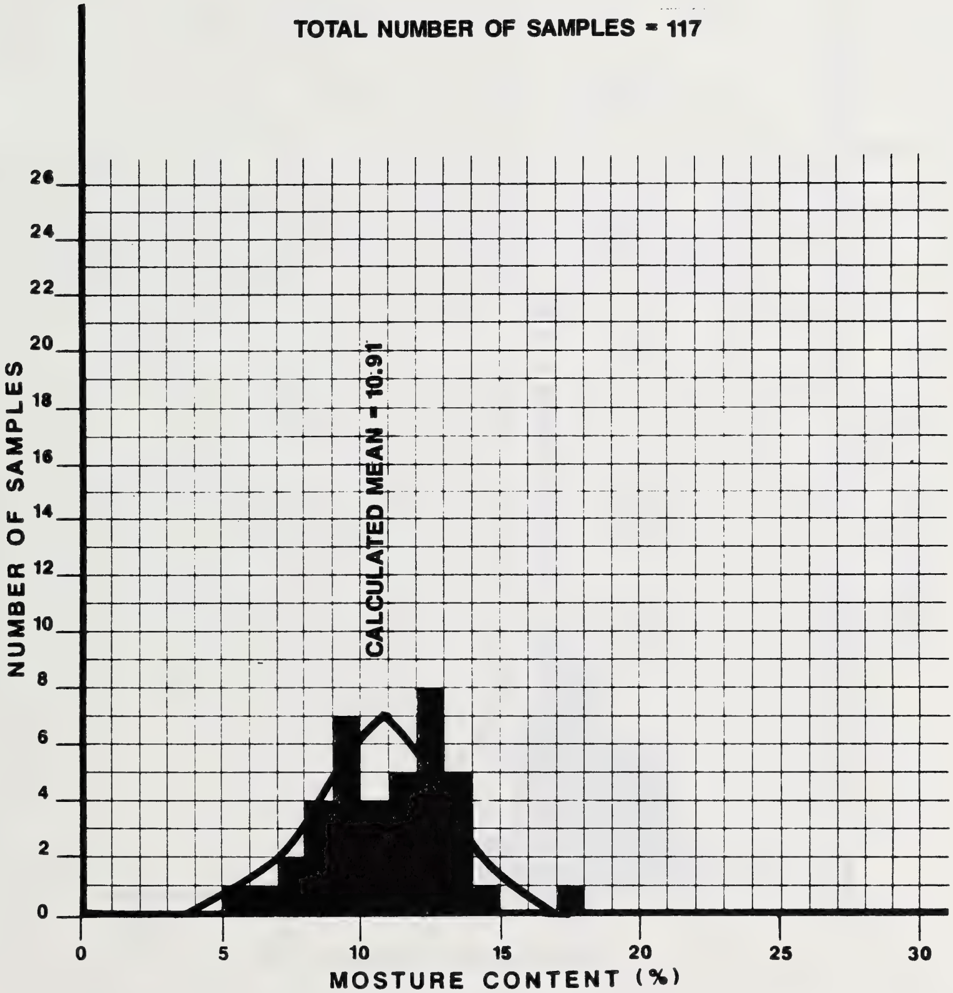
EXTERIOR STUD
12" BELOW GRADE
AVERAGE VALUE ACROSS STUD



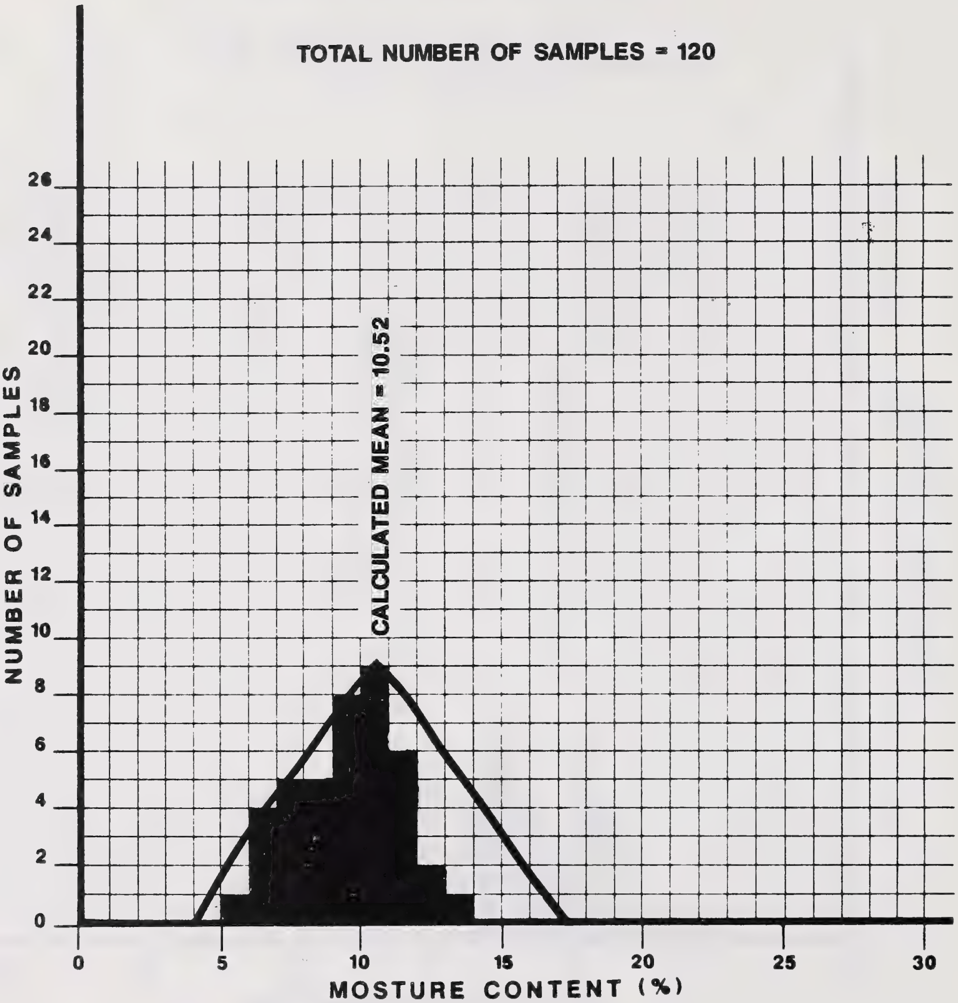
EXTERIOR STUD
TOP OF GRADE
AVERAGE VALUE ACROSS STUD



EXTERIOR STUD
12" ABOVE GRADE
AVERAGE VALUE ACROSS STUD



EXTERIOR STUD
3" BELOW TOP PLATE
AVERAGE VALUE ACROSS STUD

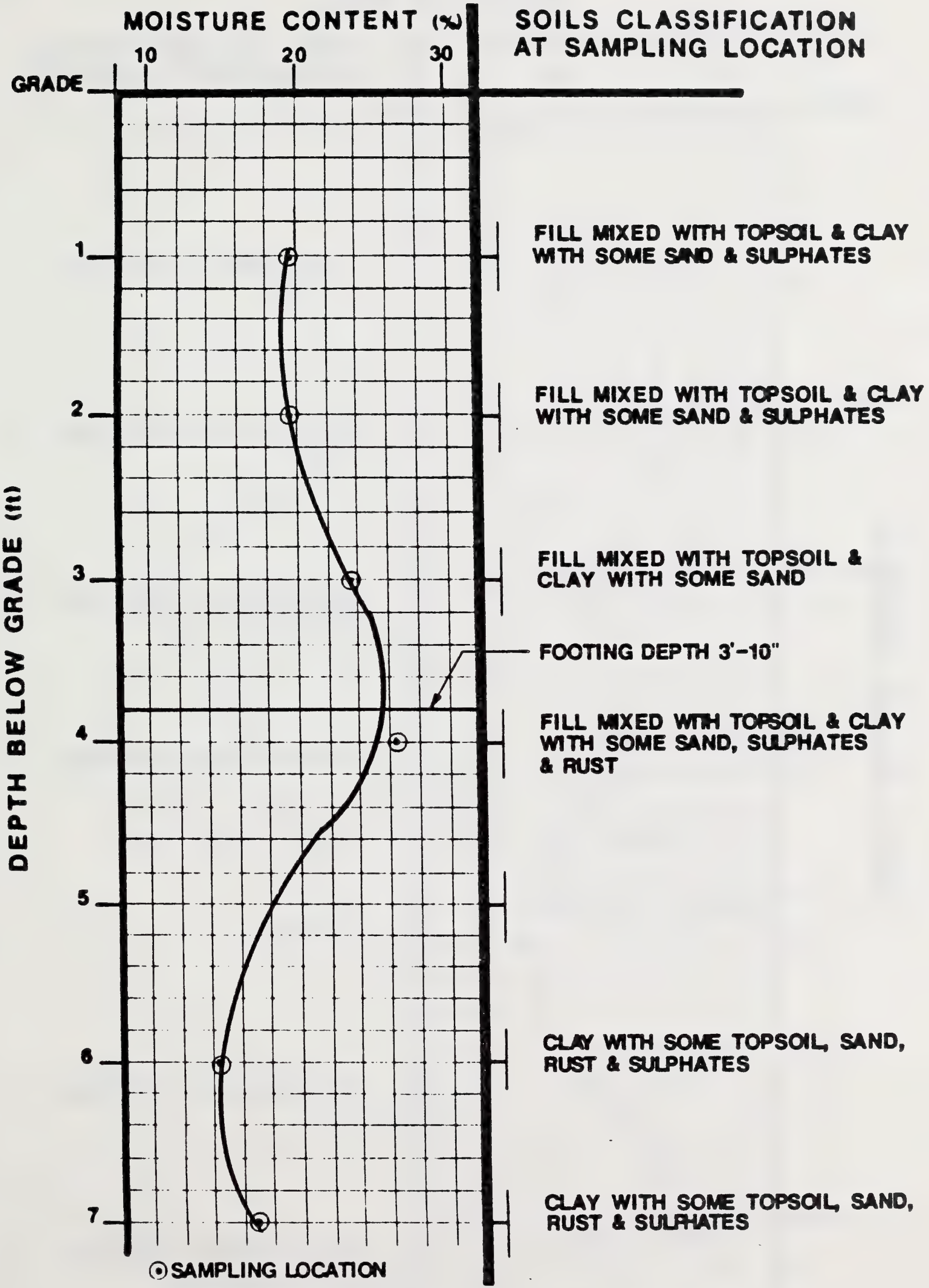


Appendix E Soil Samples

Part I Moisture Content and Soil Classification Plots.

The plots on pages E2 to E33 show the moisture profile of the soil at various depths below finished grade and the soils classification of the sample taken for testing.

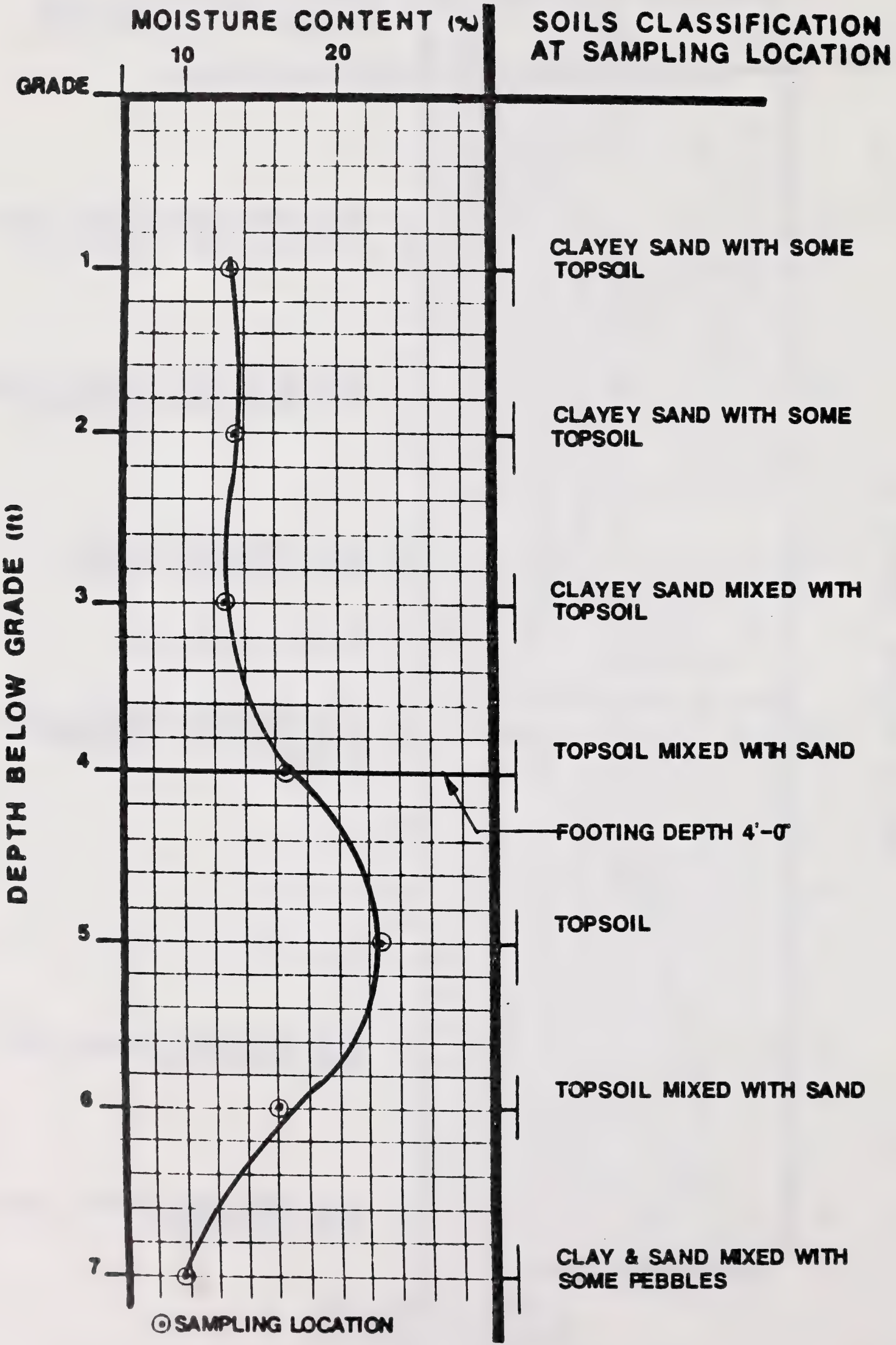
MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



PWF STUDY #1

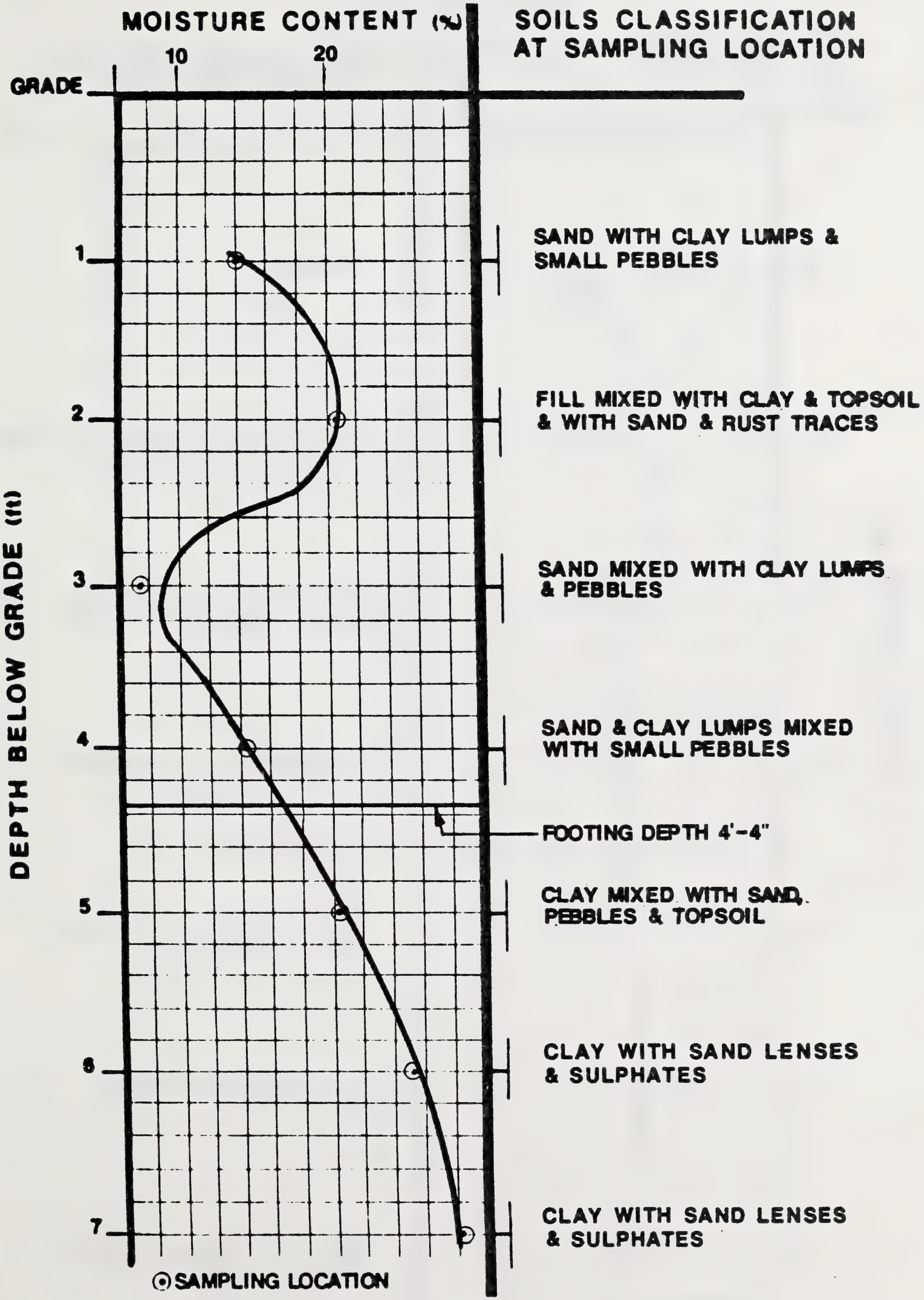
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



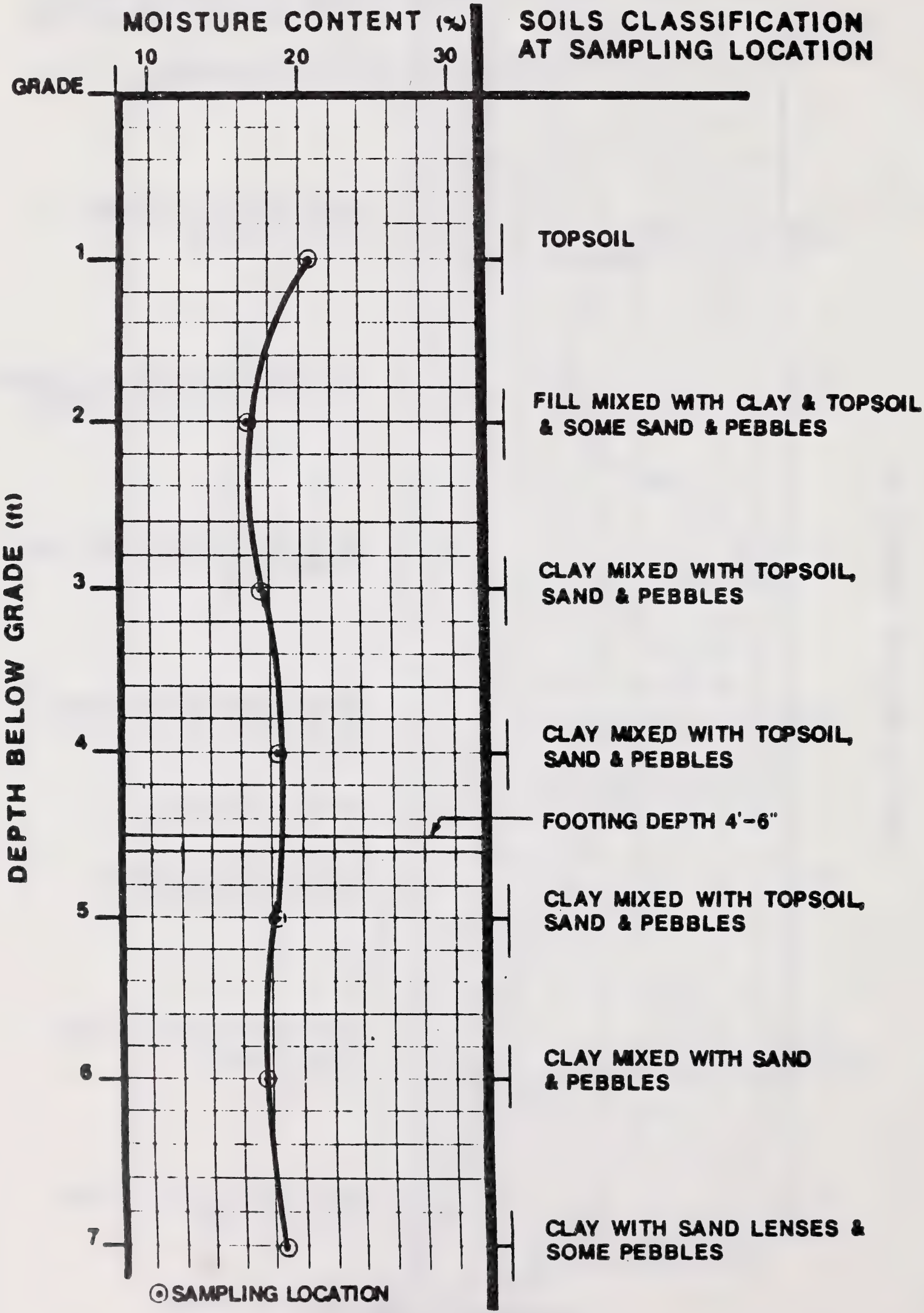
PWF STUDY #2
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



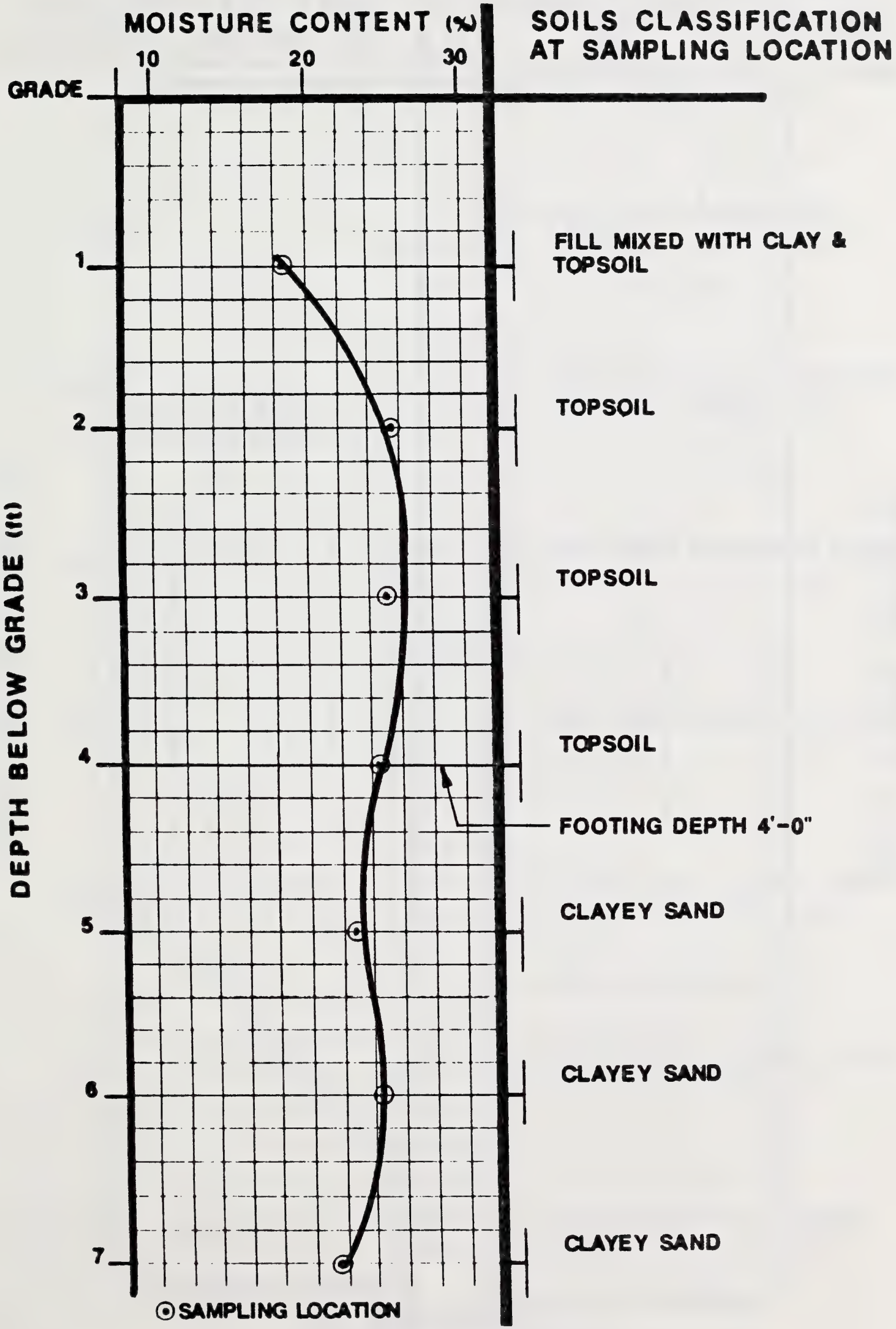
PWF STUDY #3
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



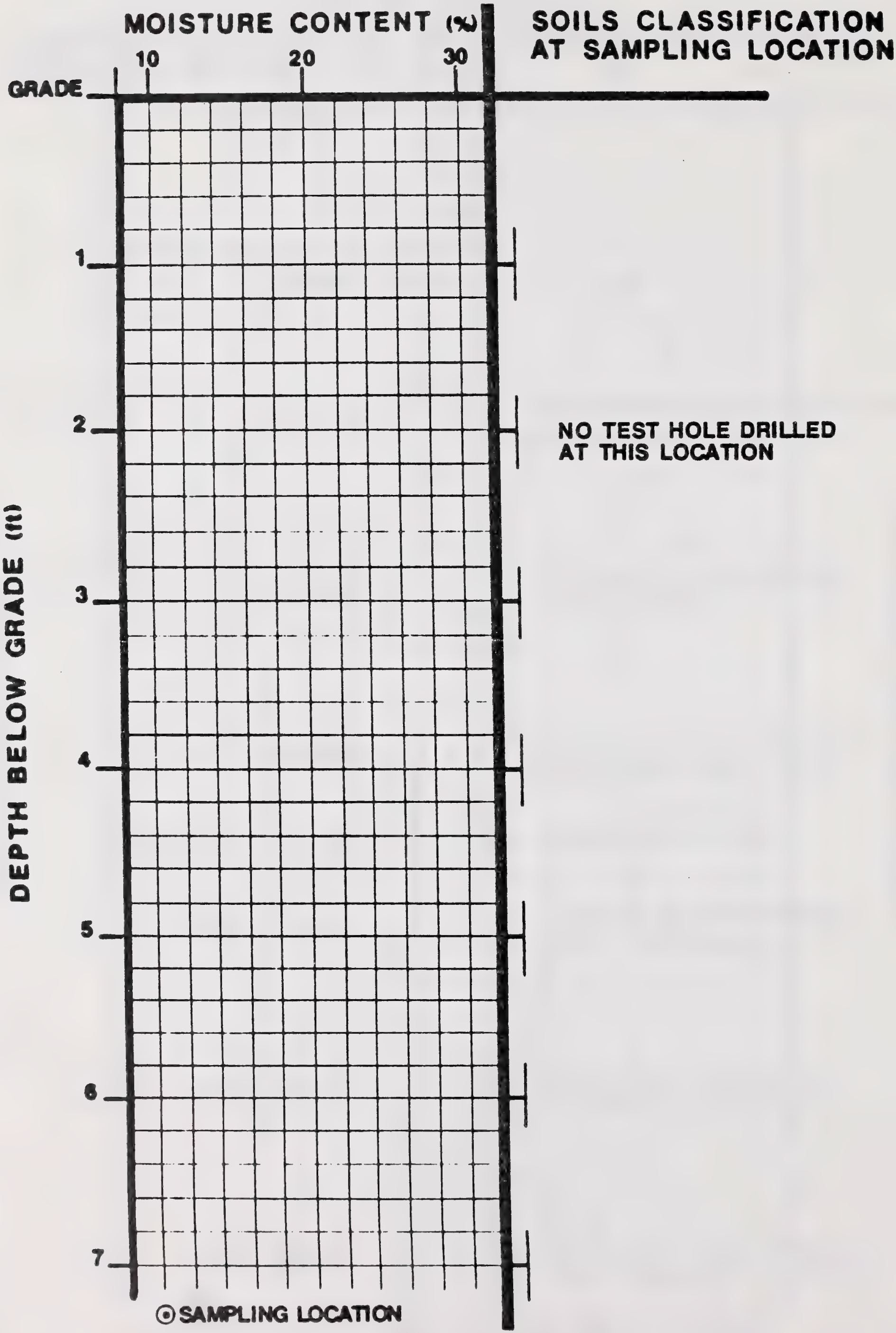
PWF STUDY #4
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



PWF STUDY #5
DRAINAGE IS POSITIVE

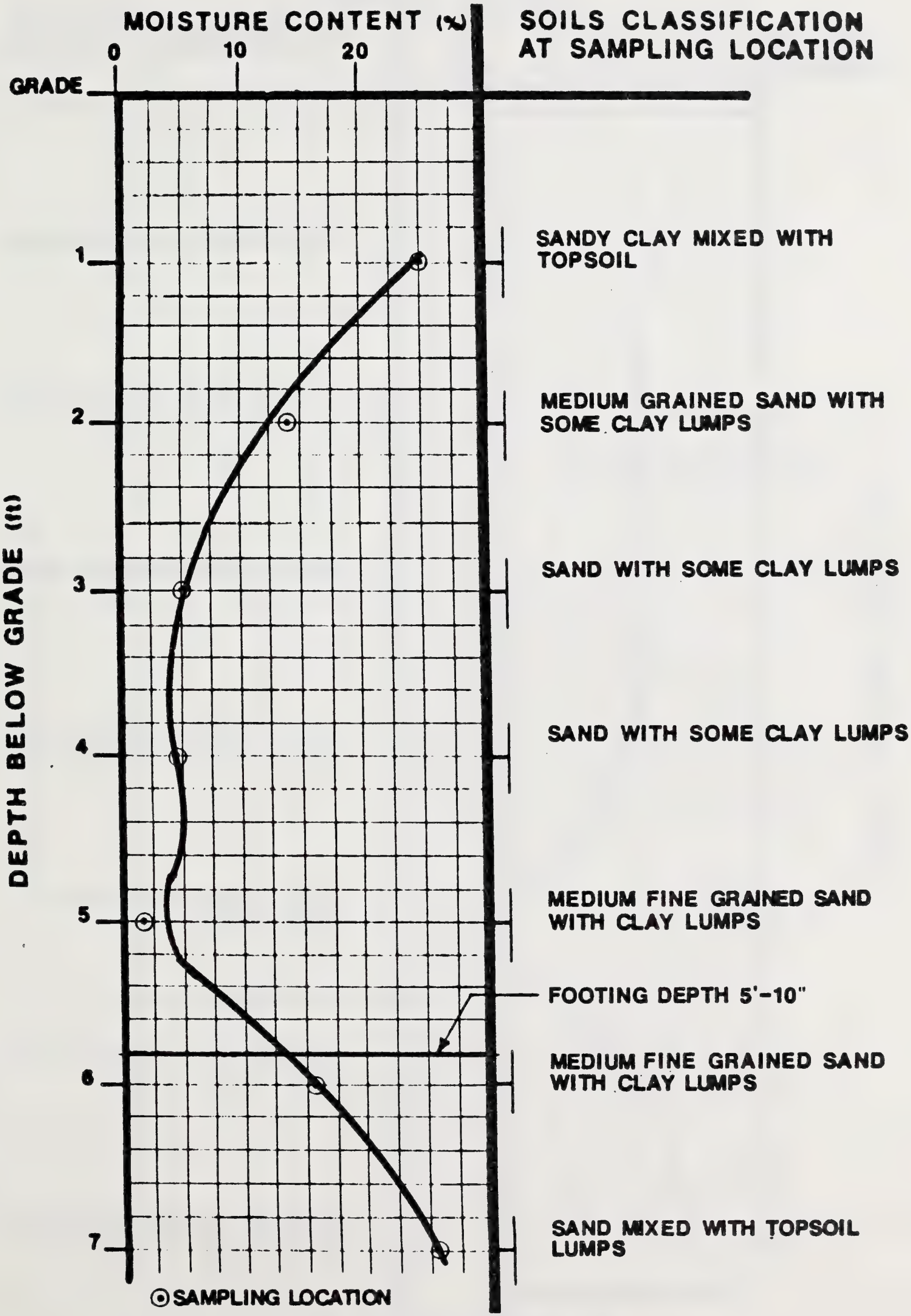
MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



NO TEST HOLE DRILLED
AT THIS LOCATION

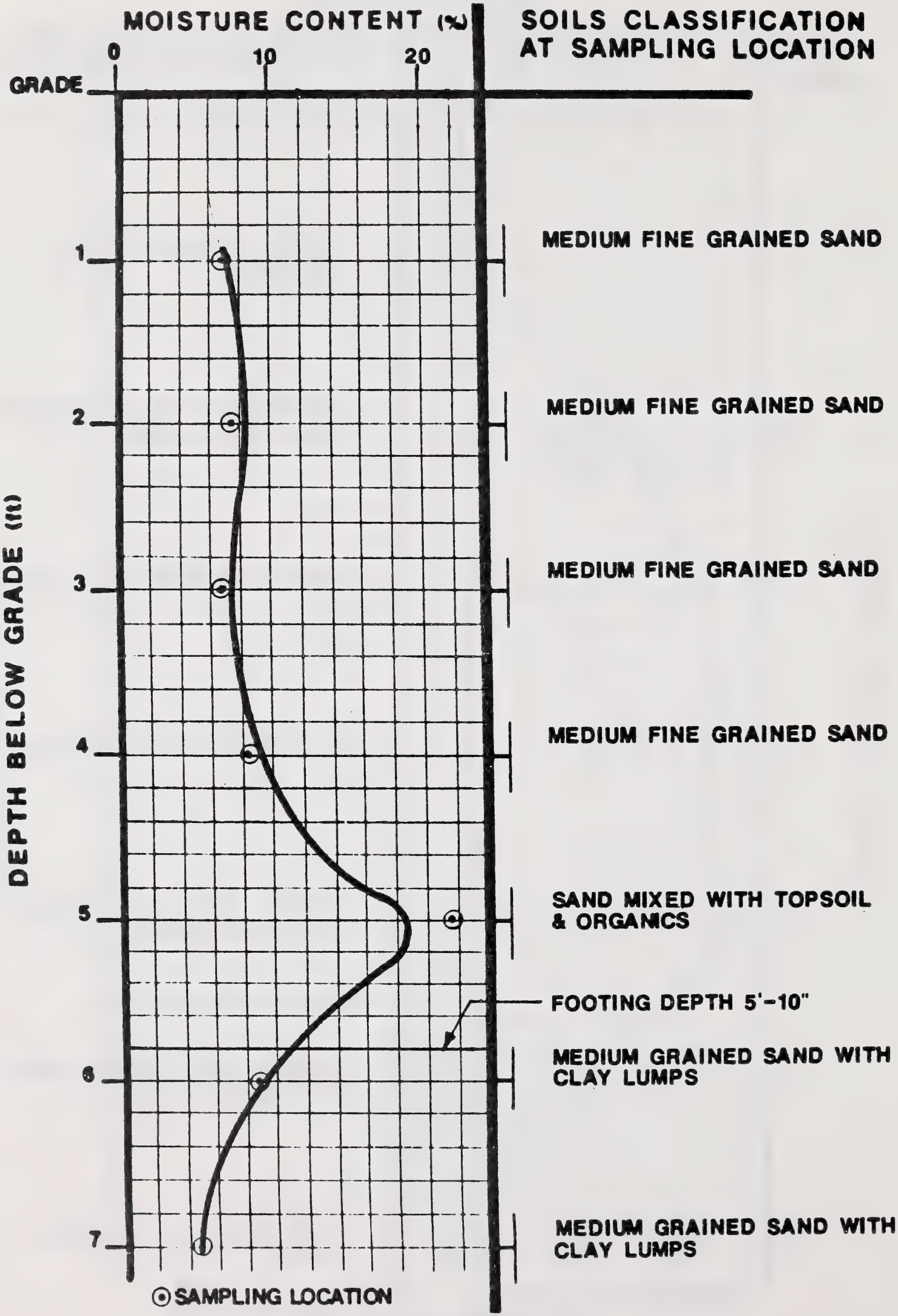
PWF STUDY #6
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



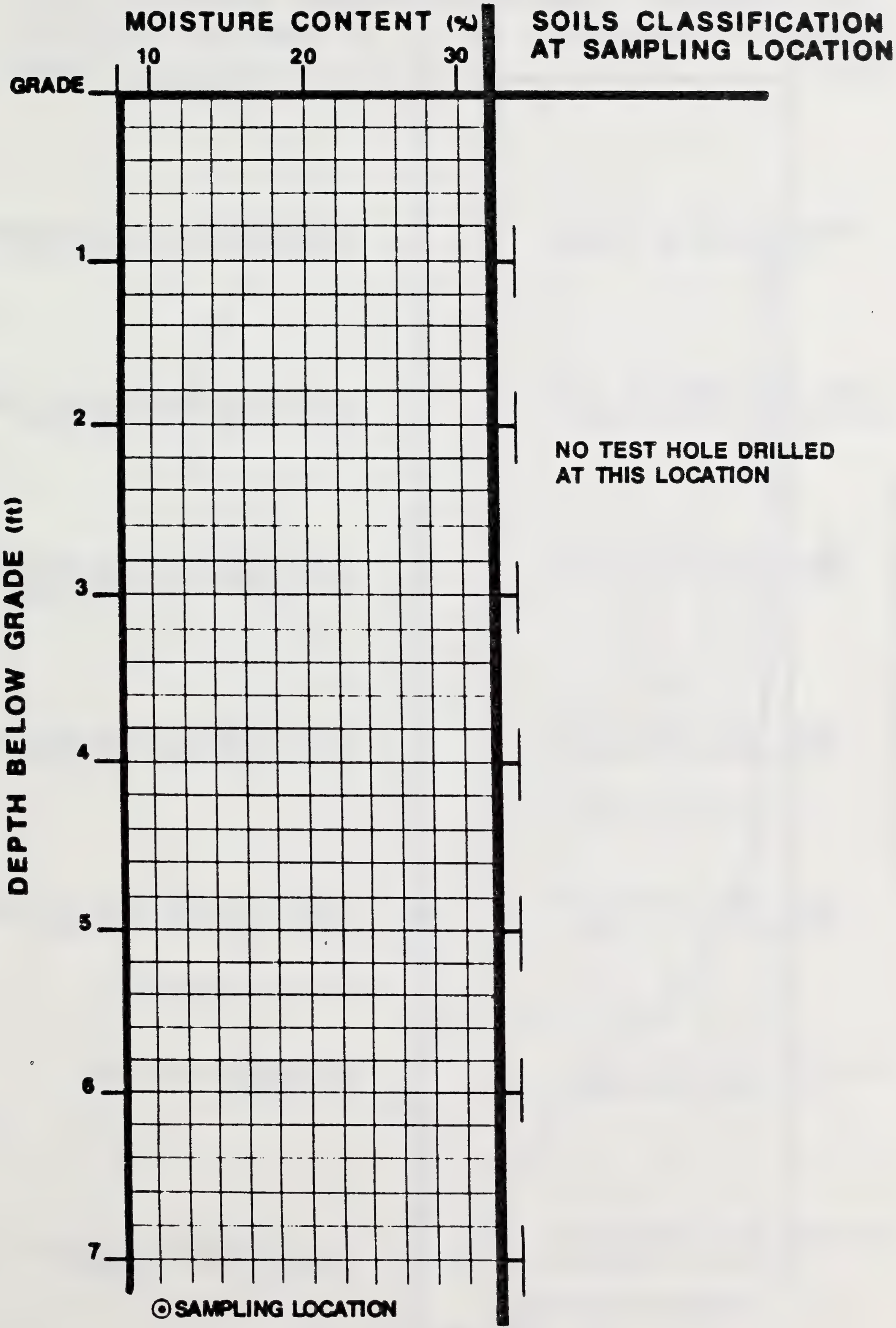
PWF STUDY #7
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



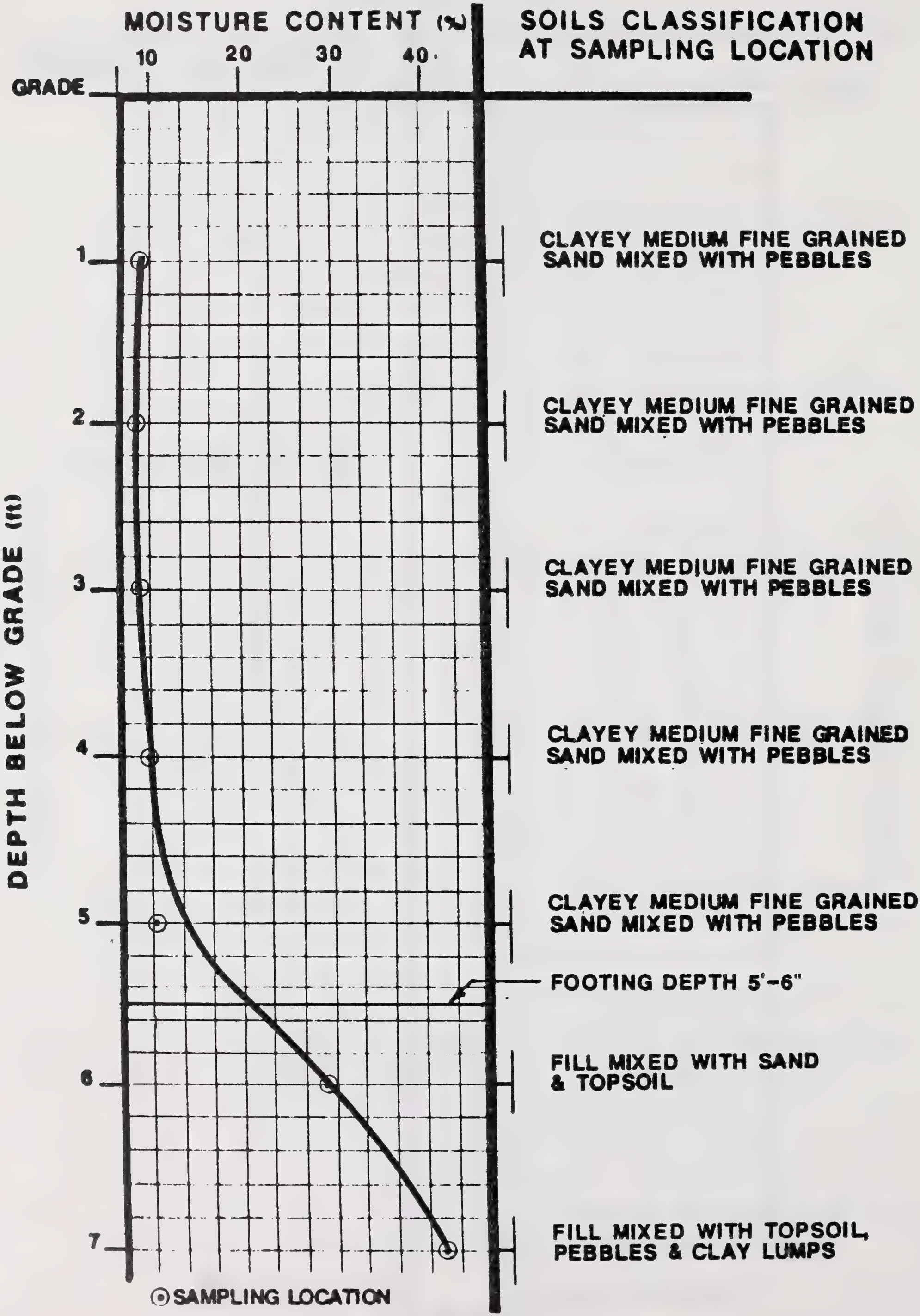
PWF STUDY #8
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



PWF STUDY #9
DRAINAGE IS NEGATIVE

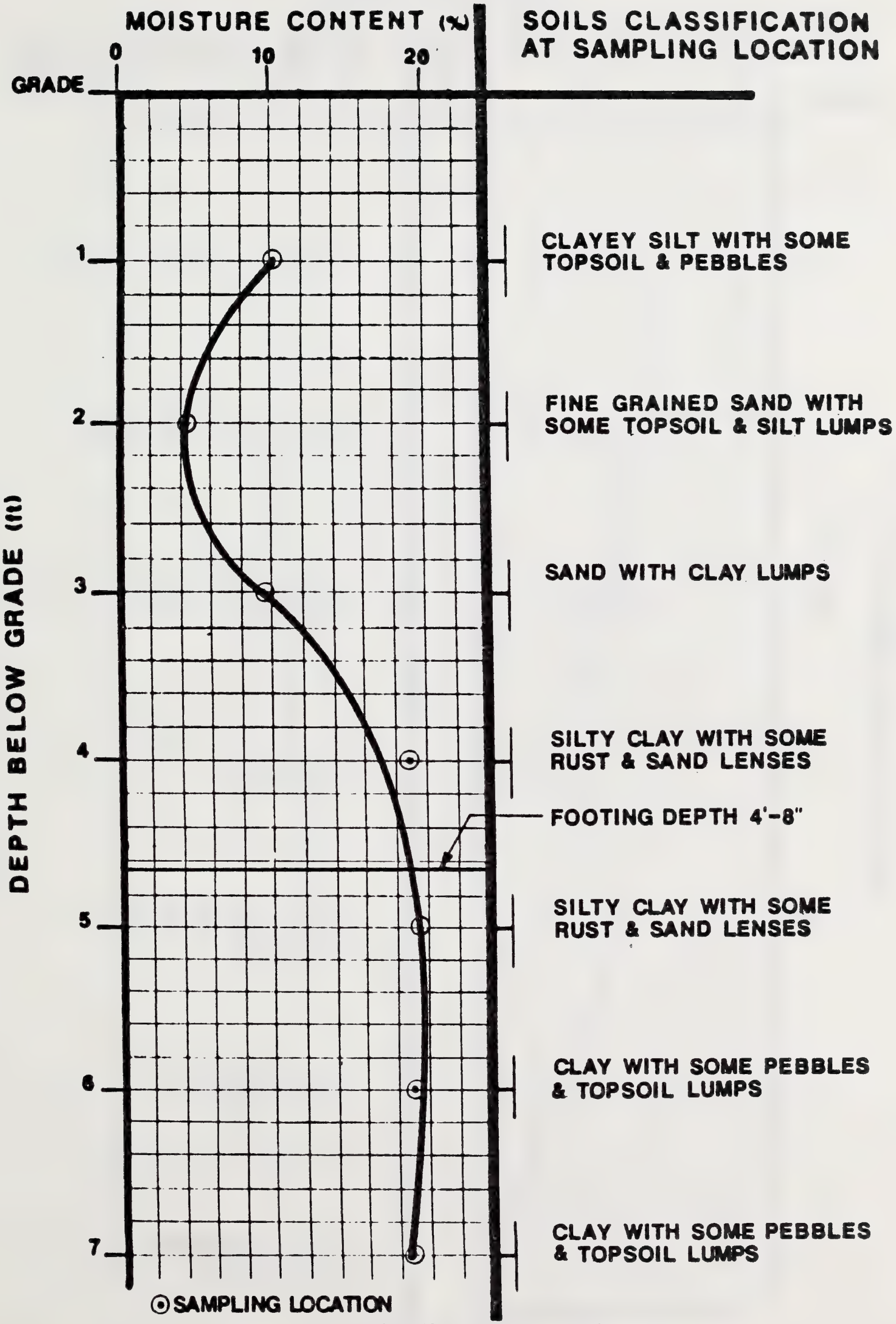
MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



PWF STUDY #10

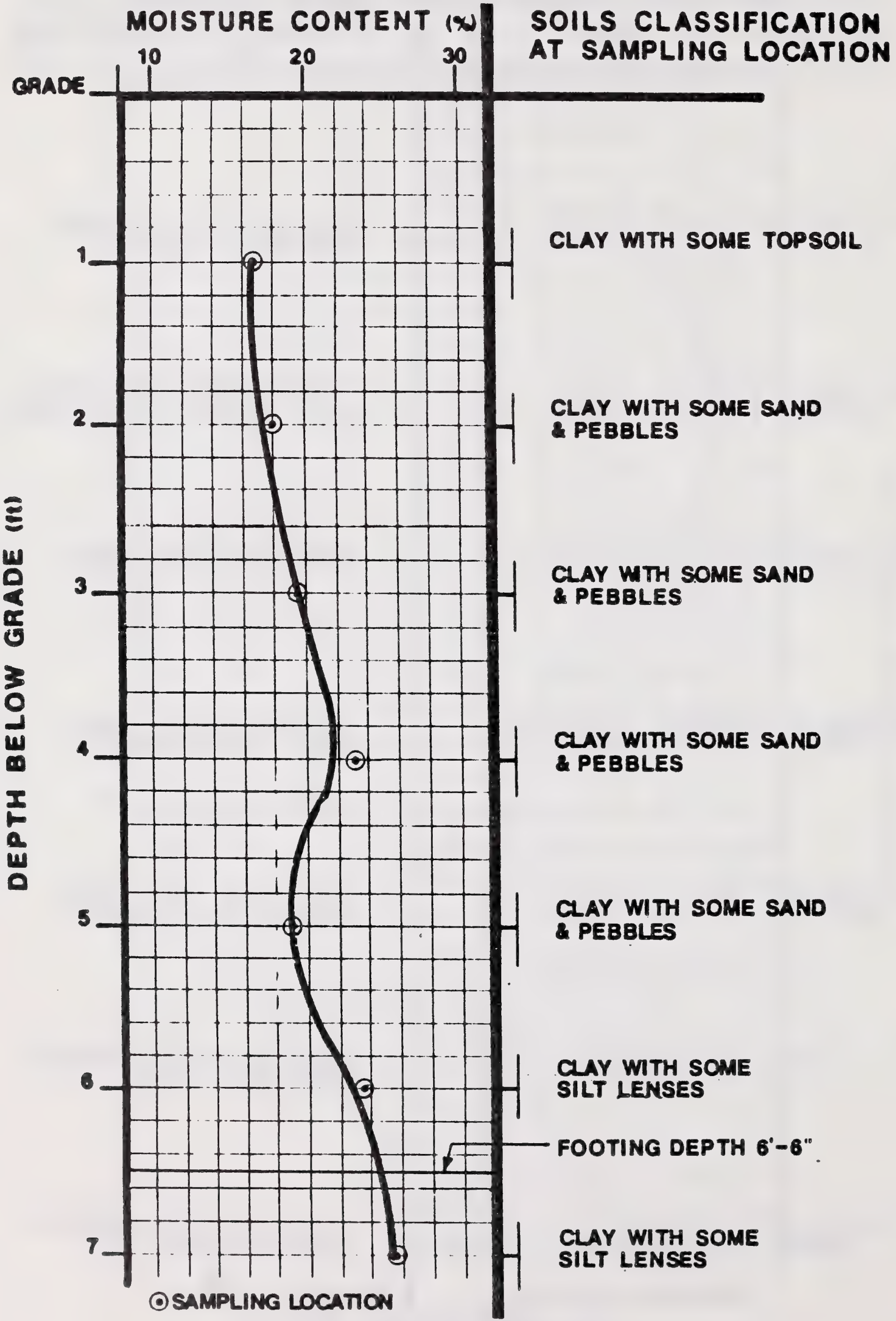
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



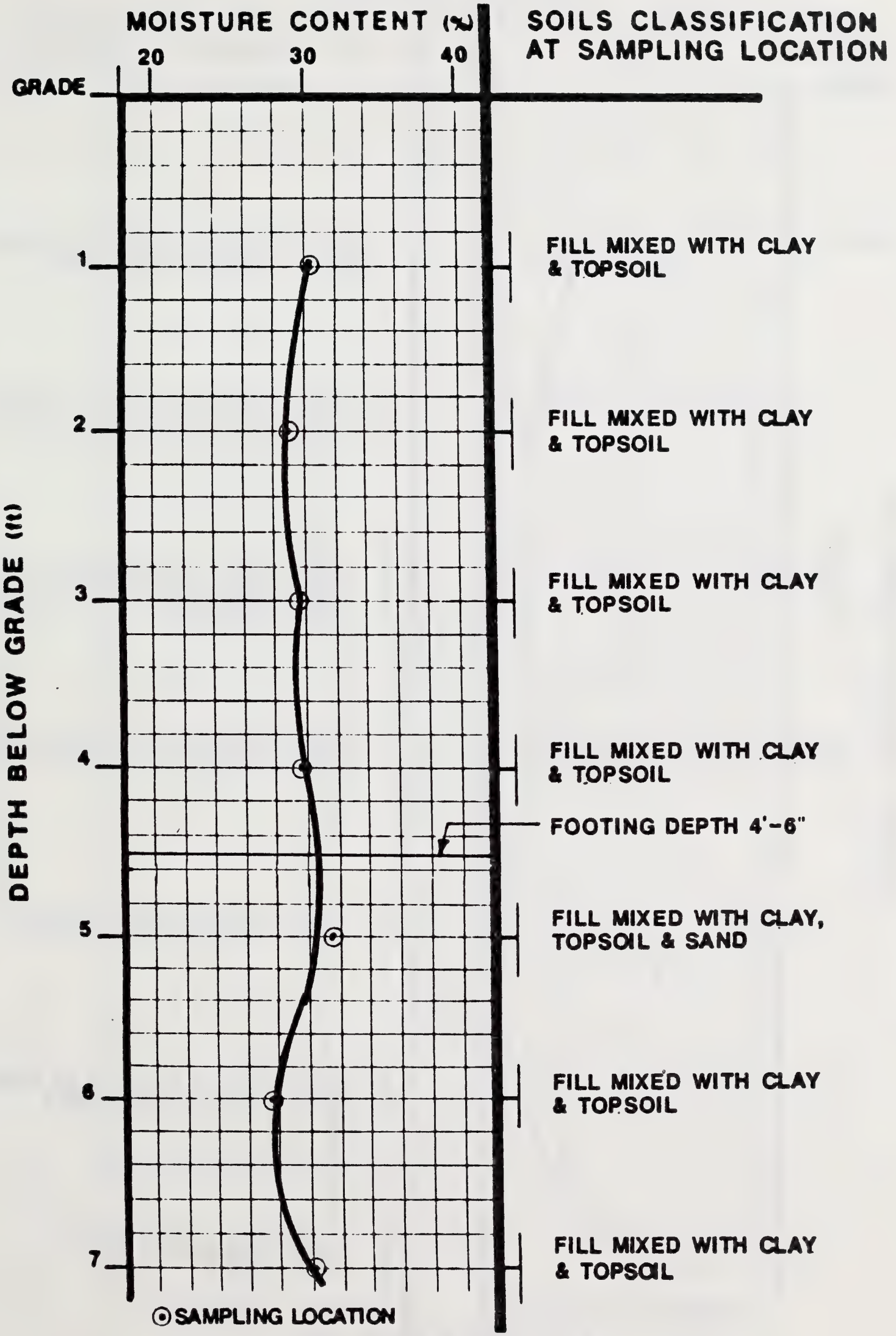
PWF STUDY #11
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



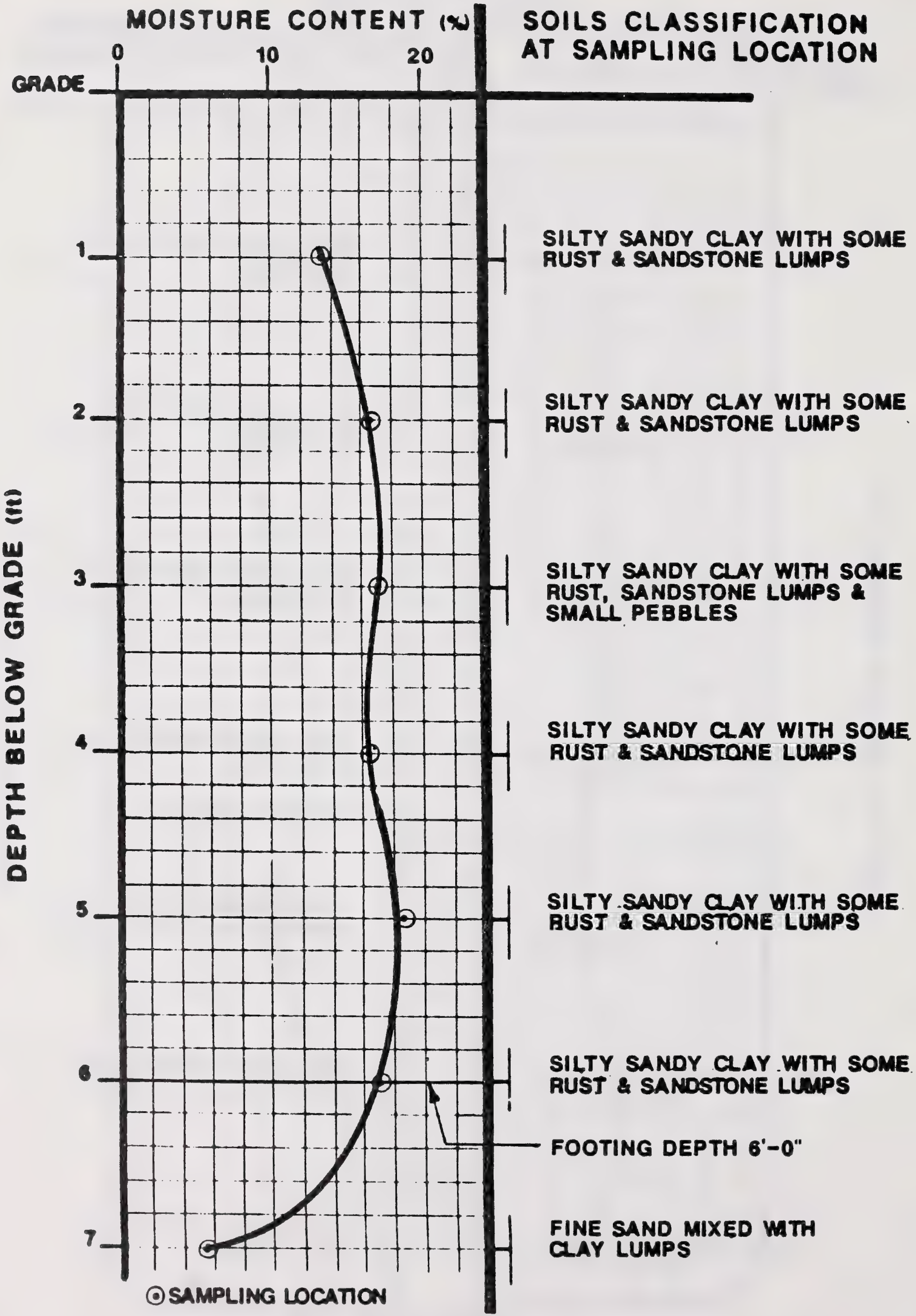
PWF STUDY #12
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



PWF STUDY #13
DRAINAGE IS NEGATIVE

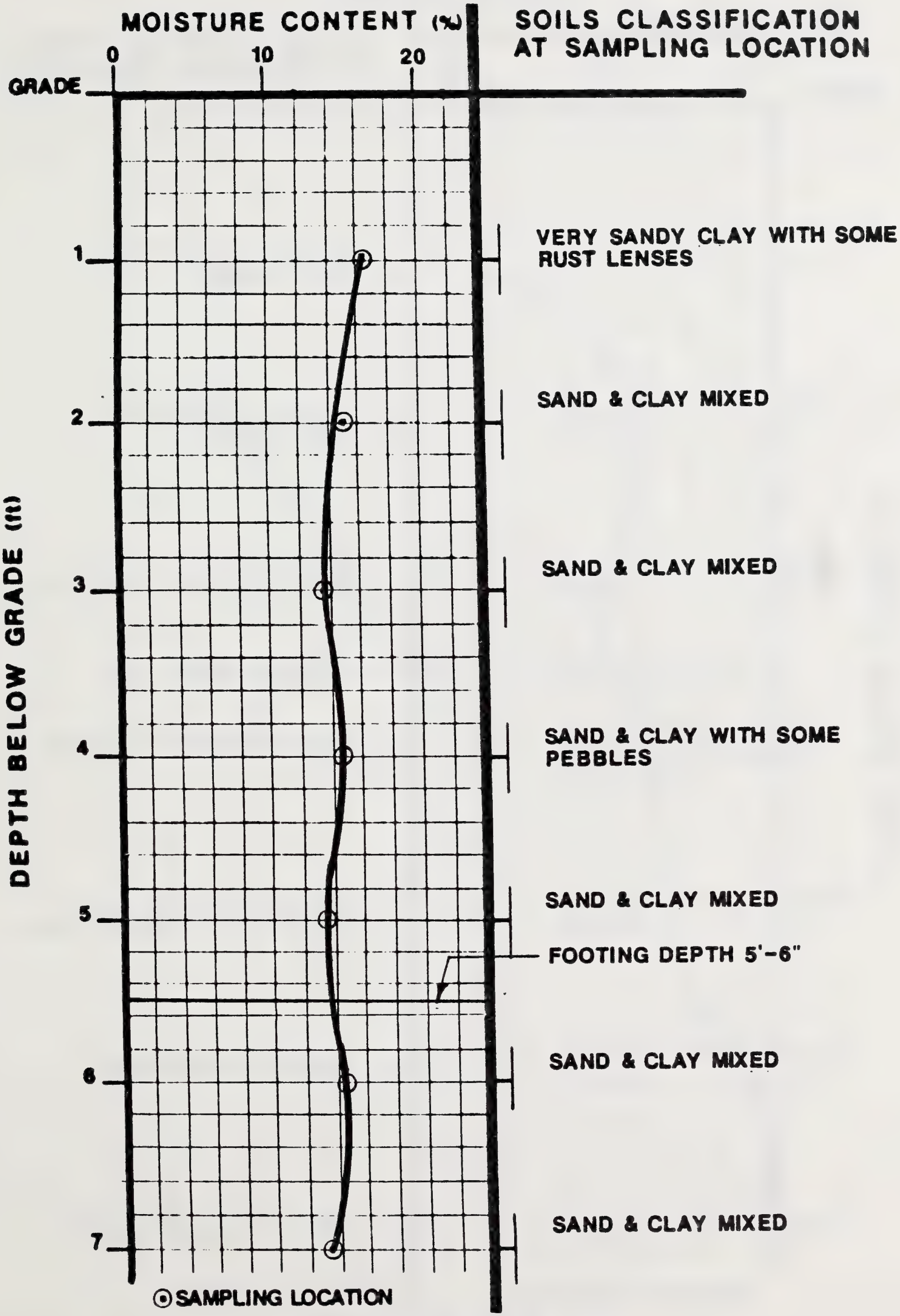
MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



PWF STUDY #14

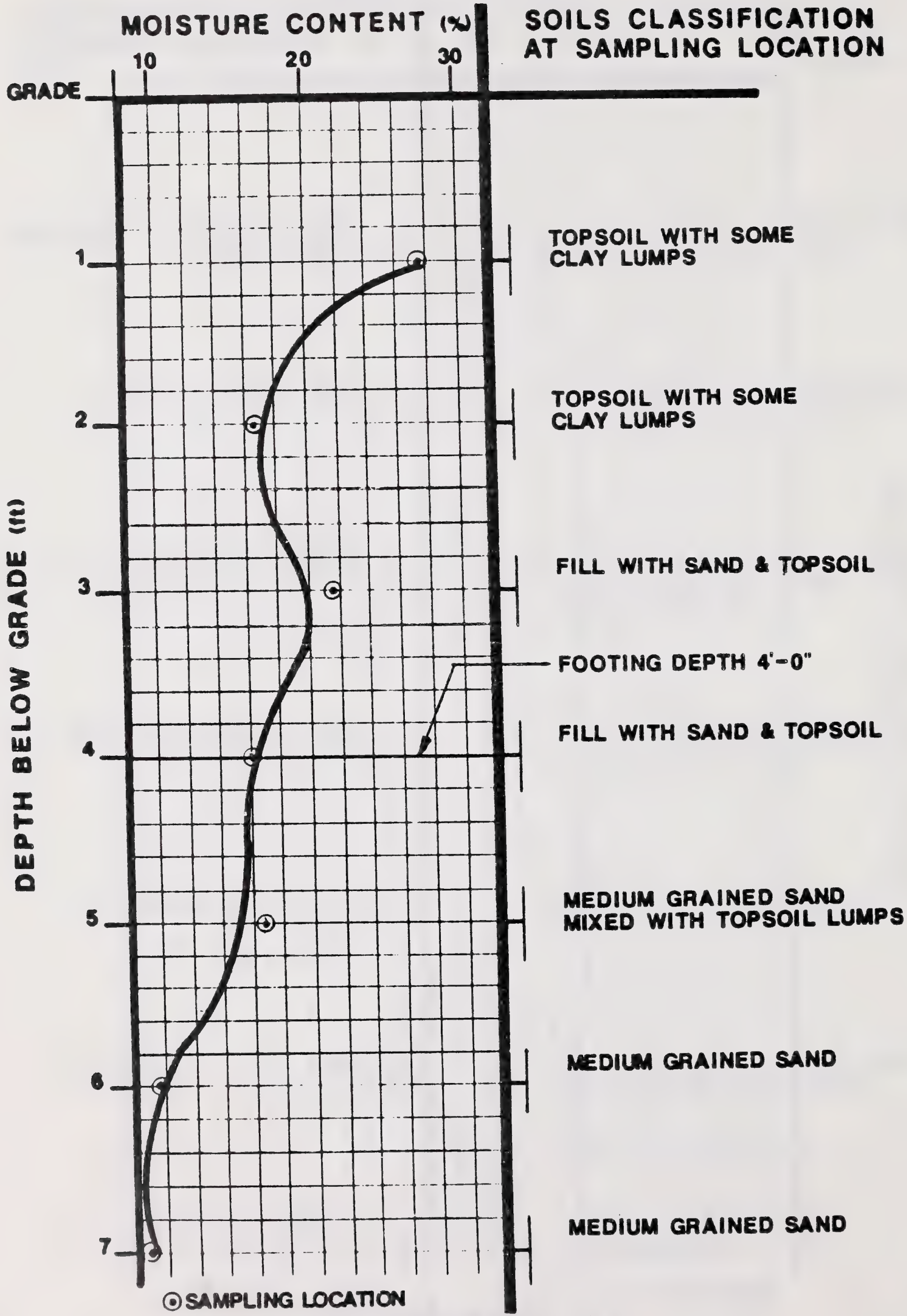
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



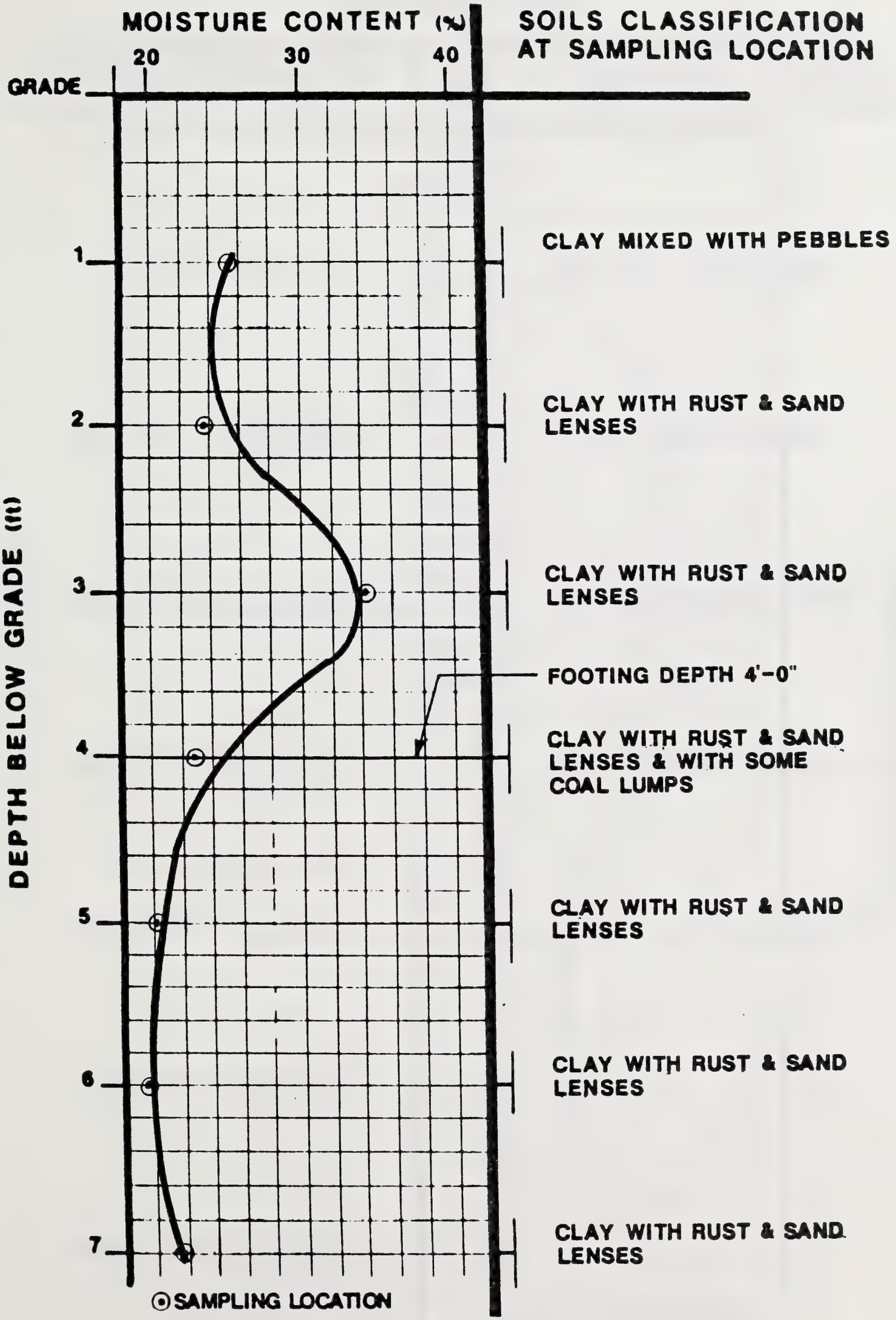
PWF STUDY #15
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



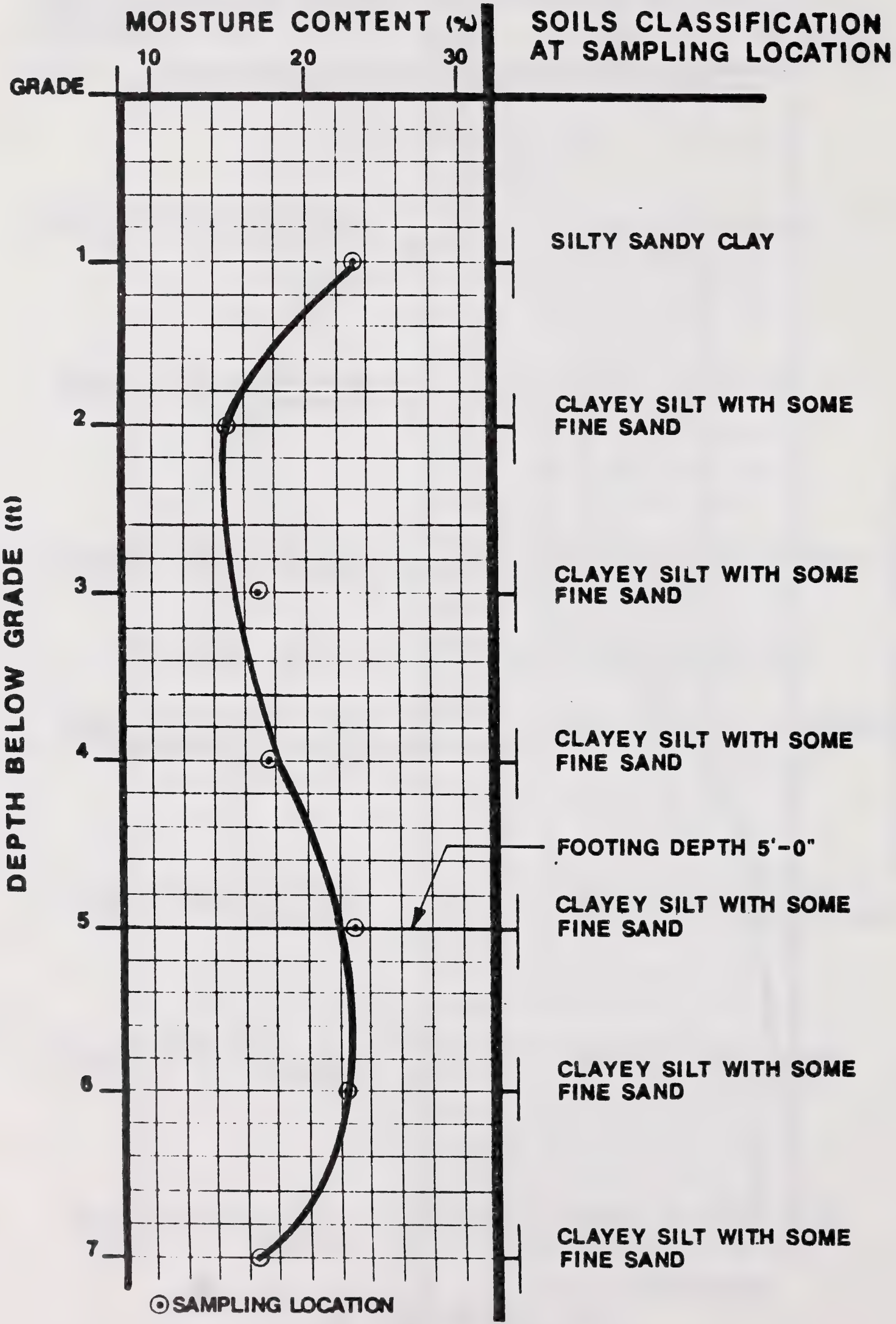
PWF STUDY #16
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



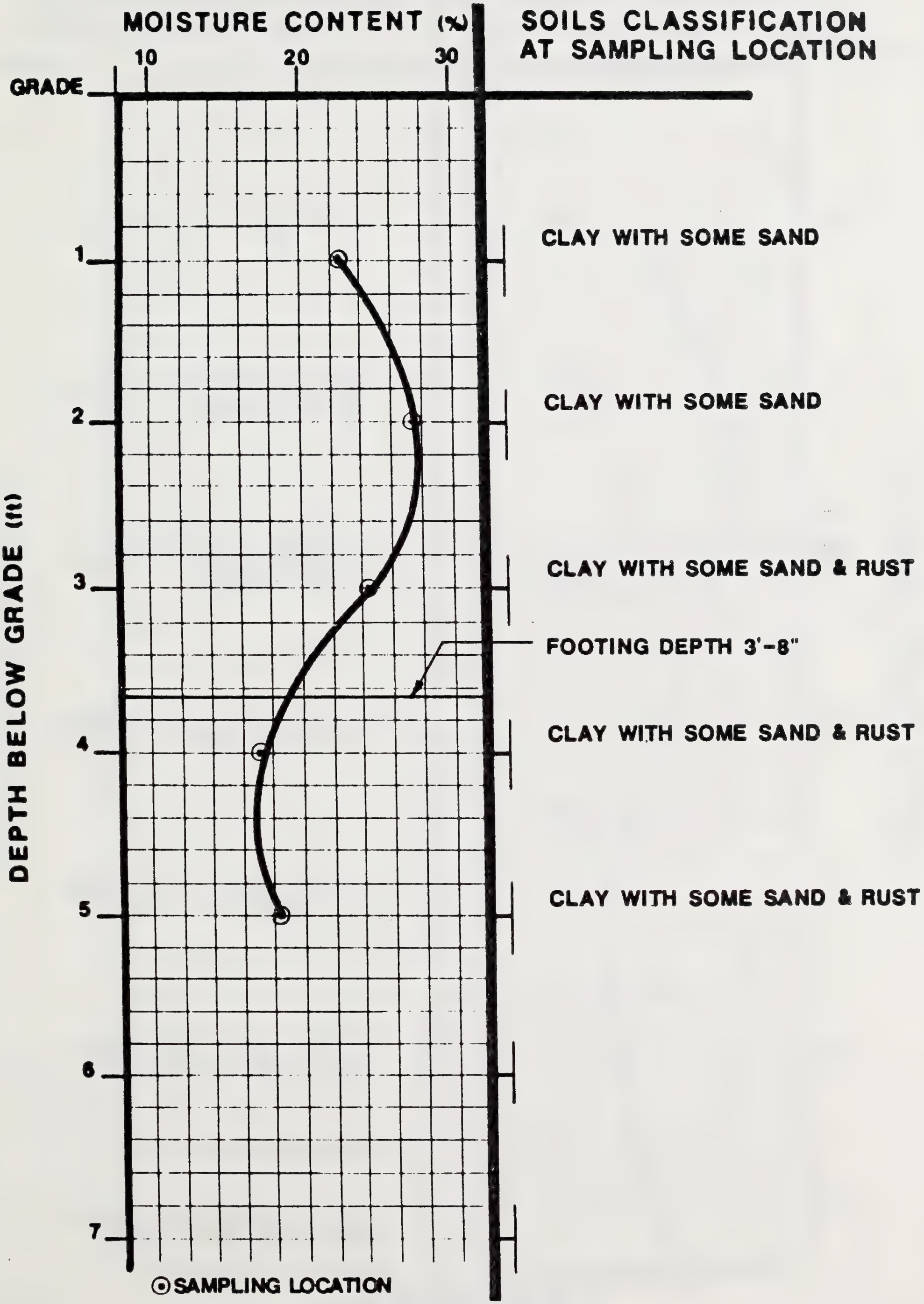
PWF STUDY #17
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



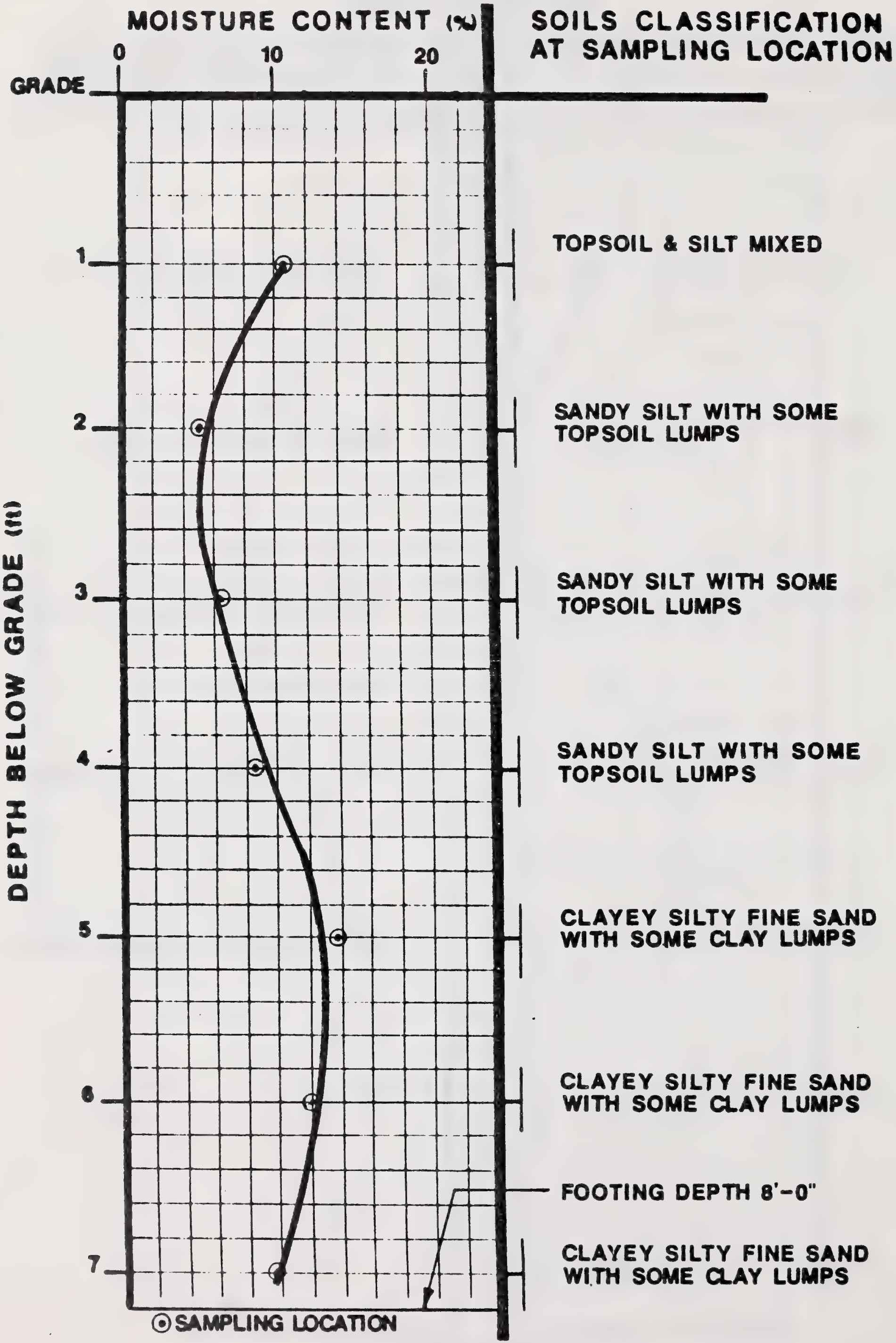
PWF STUDY #18
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



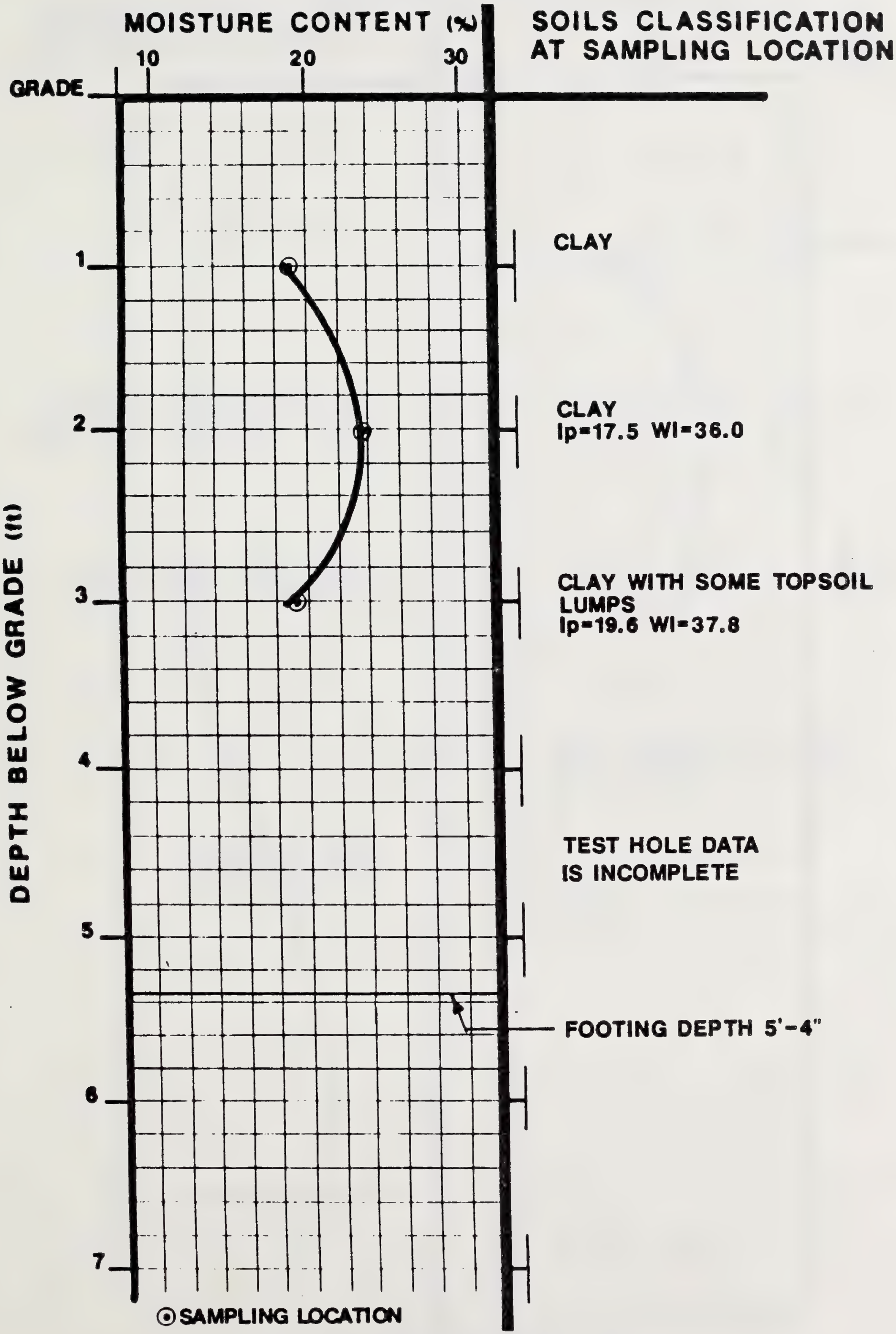
PWF STUDY #19
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



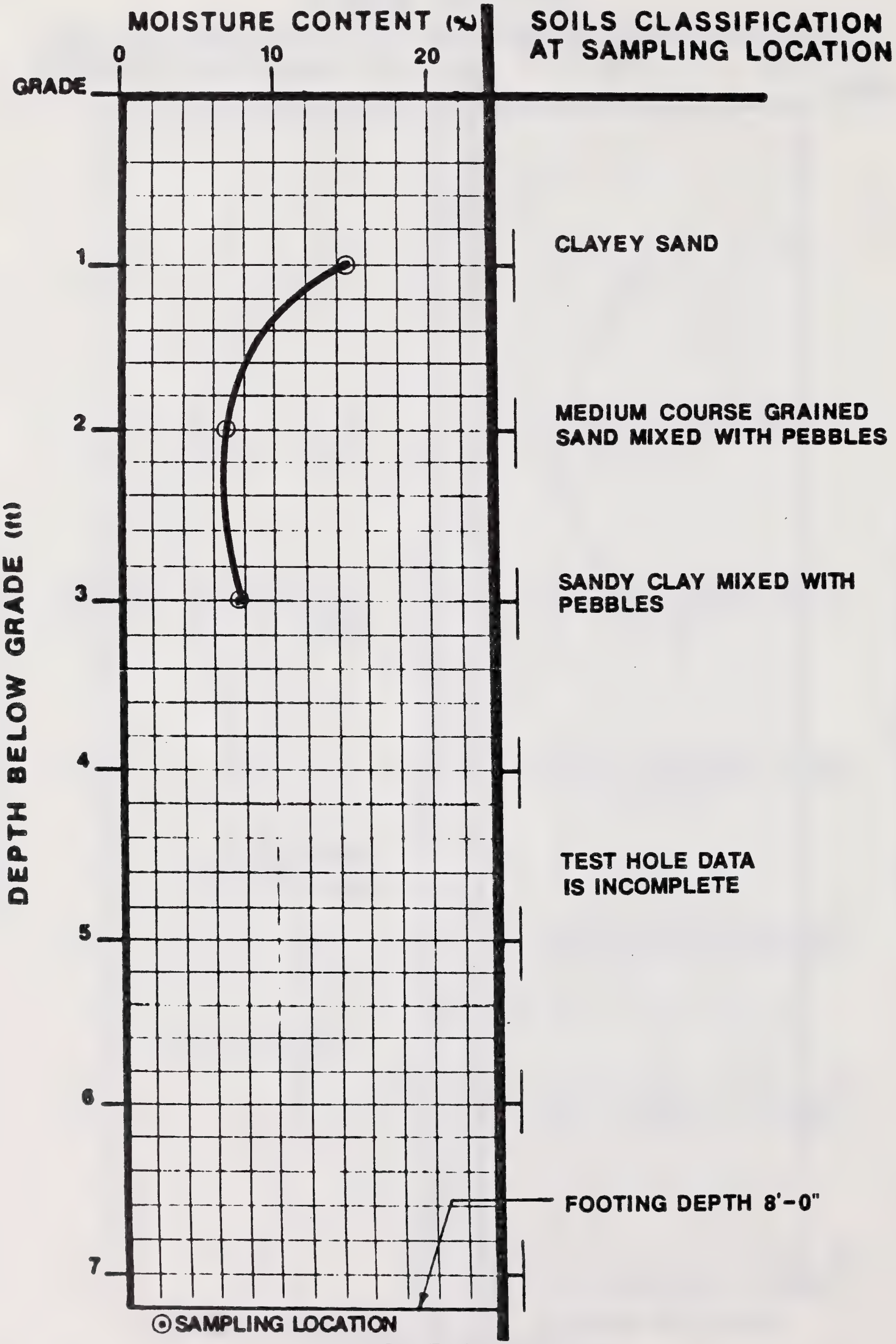
PWF STUDY #20
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



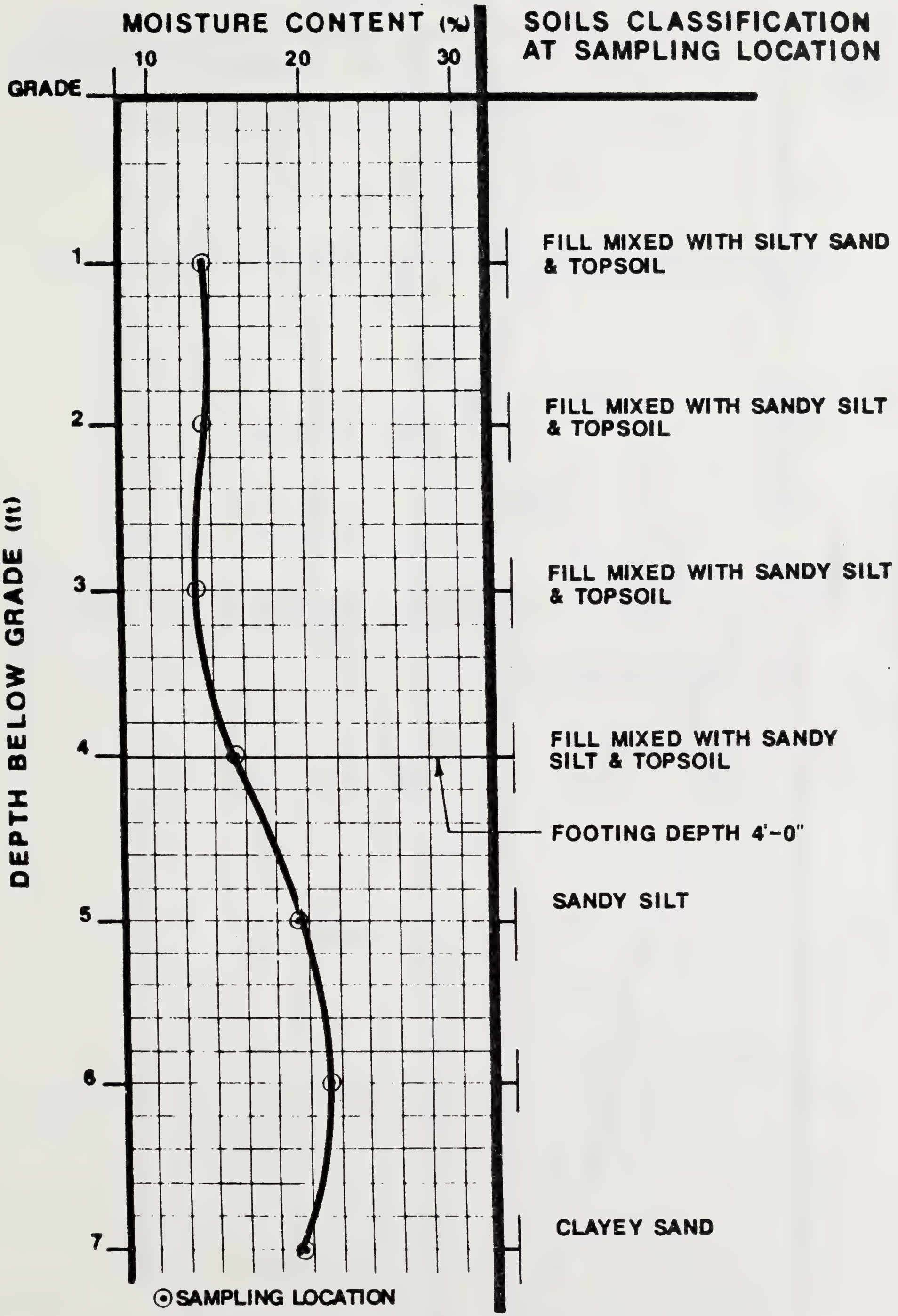
PWF STUDY #21
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL



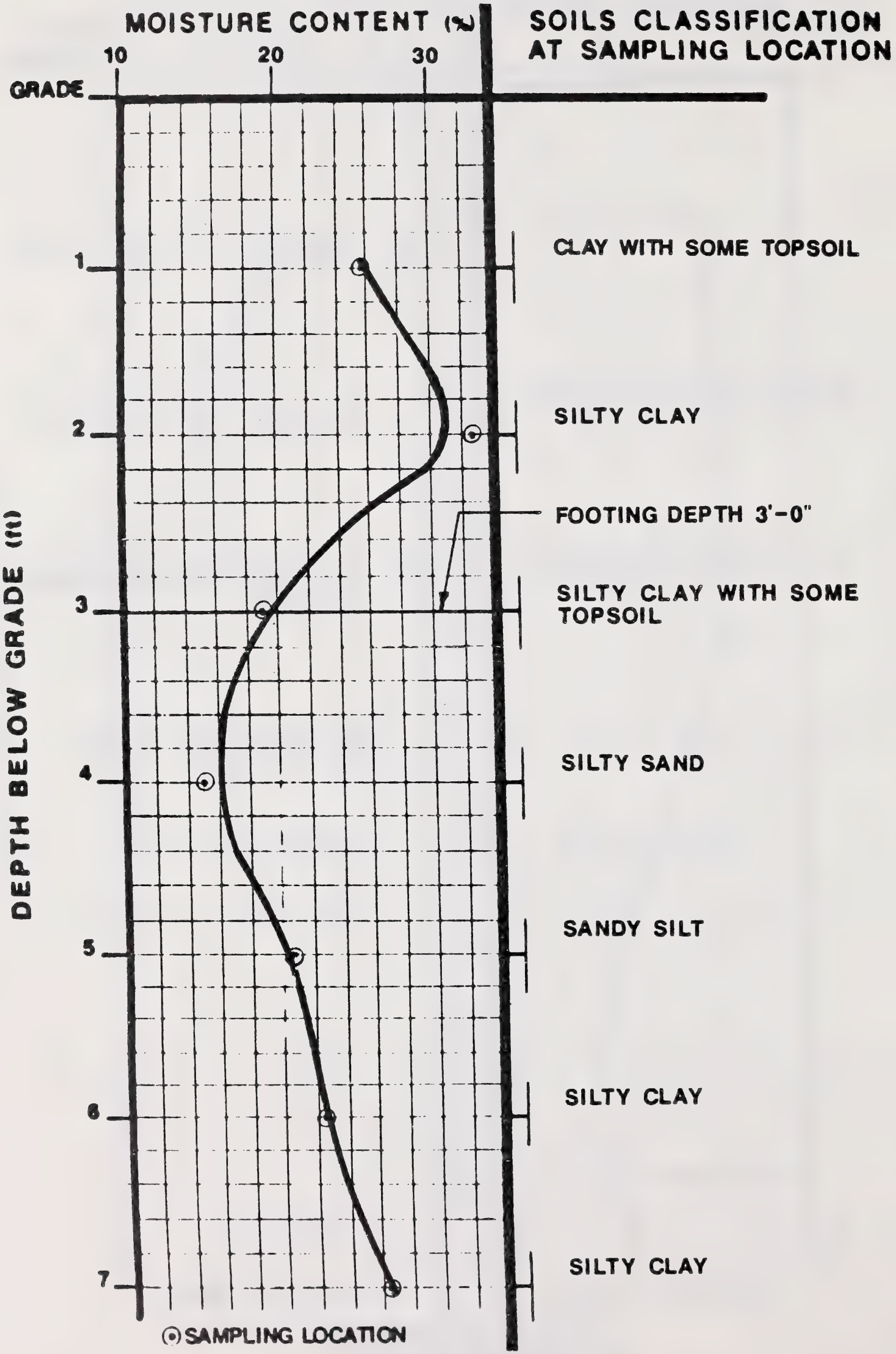
PWF STUDY #22
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



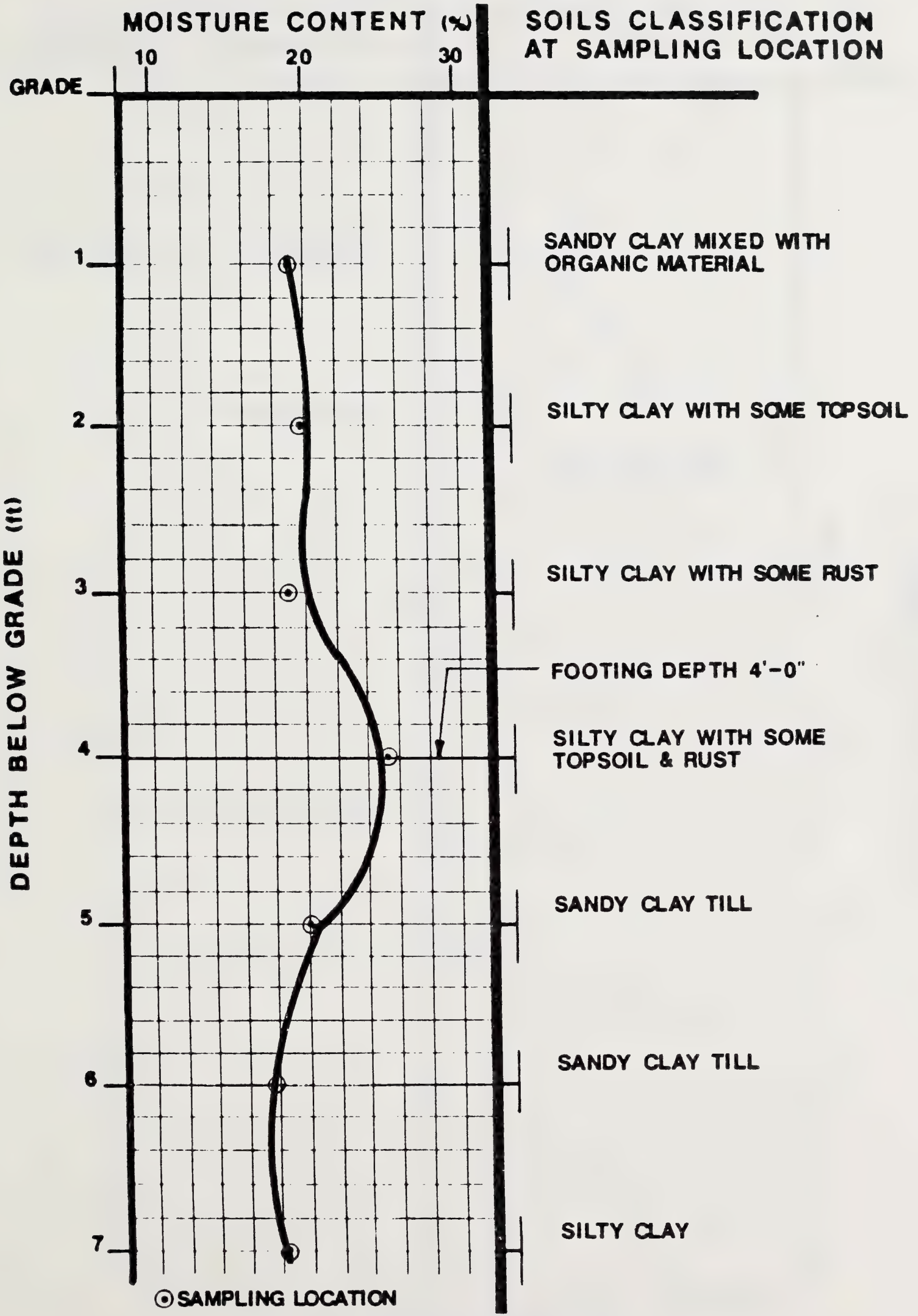
PWF STUDY #23
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



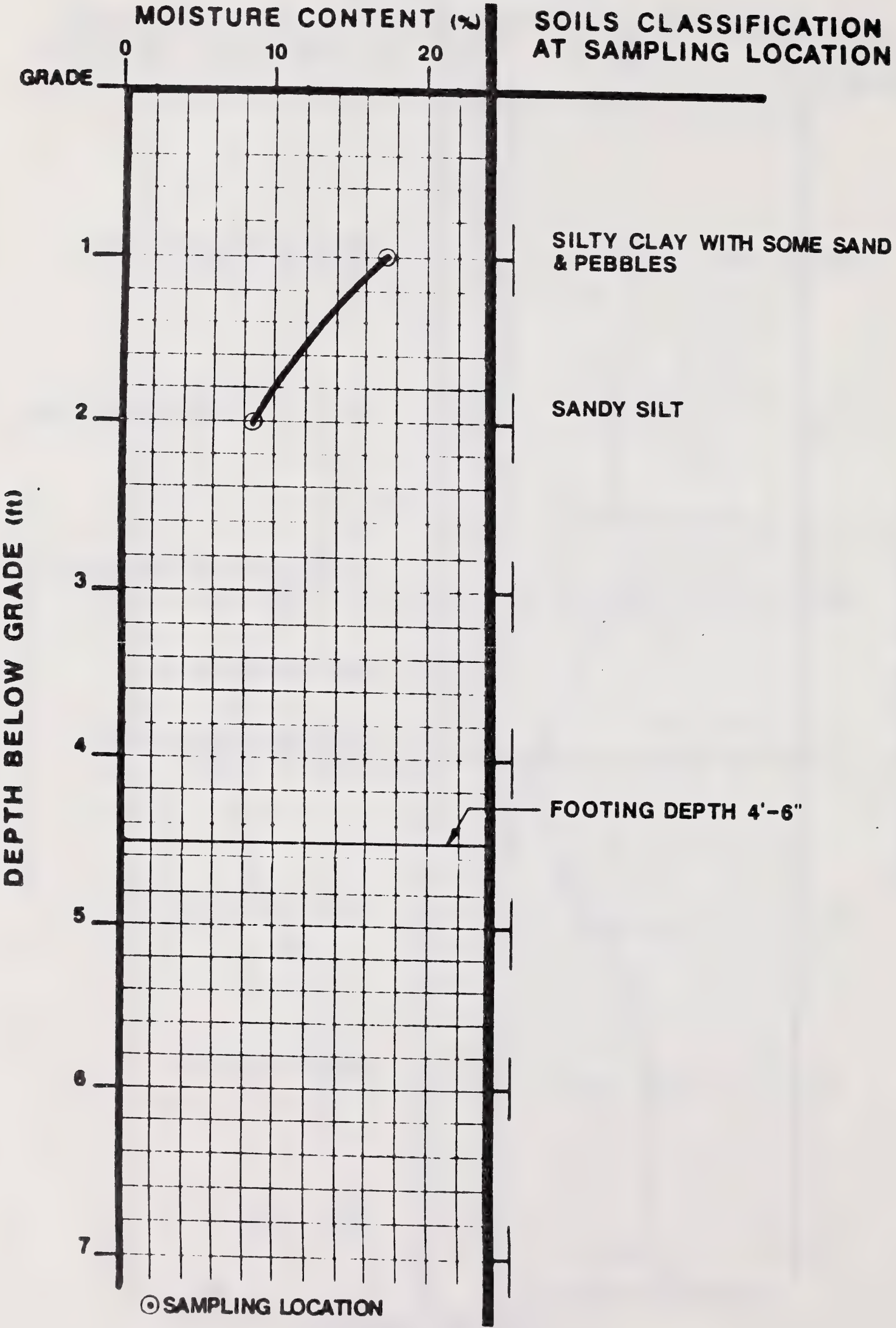
PWF STUDY #24
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



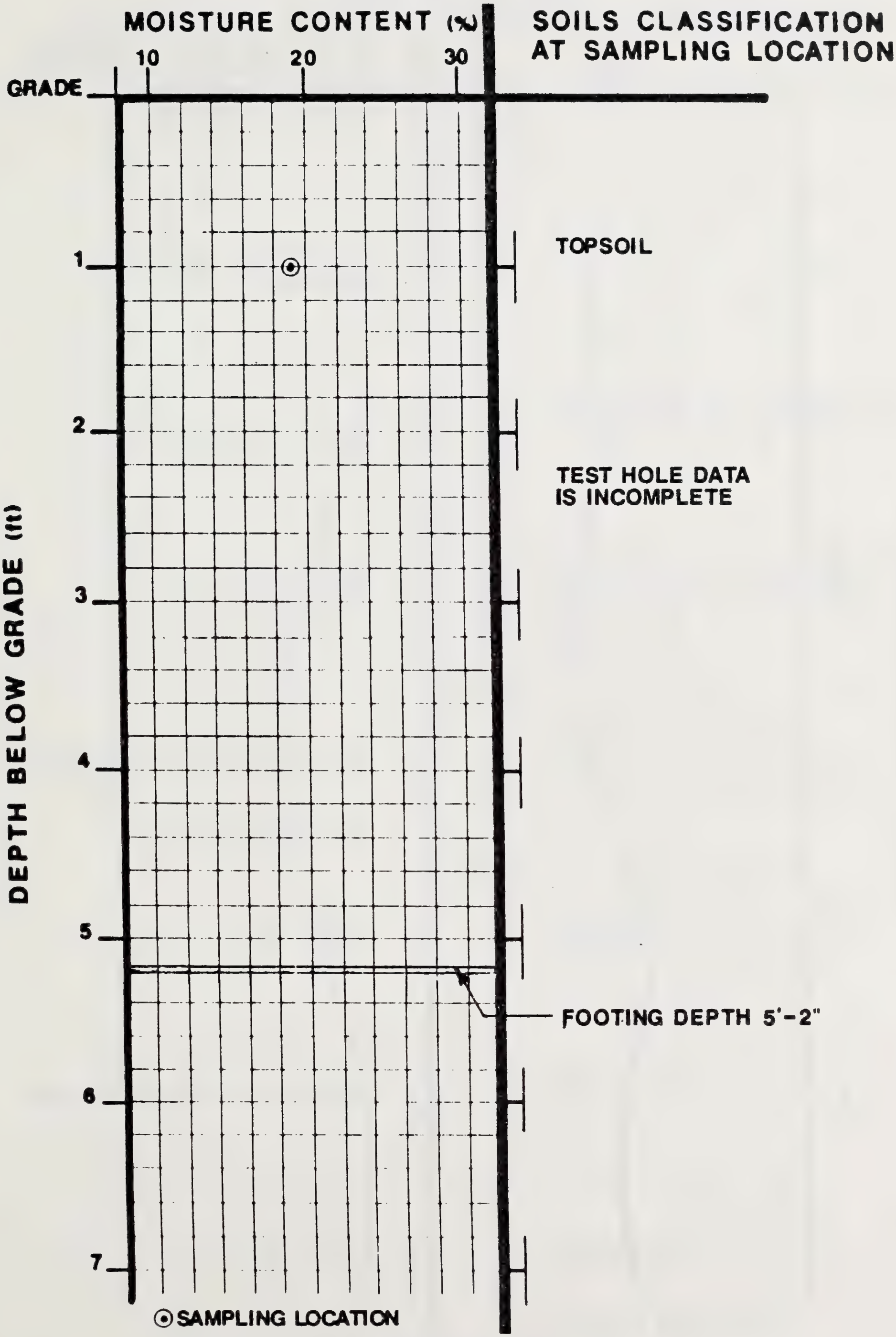
PWF STUDY #25
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



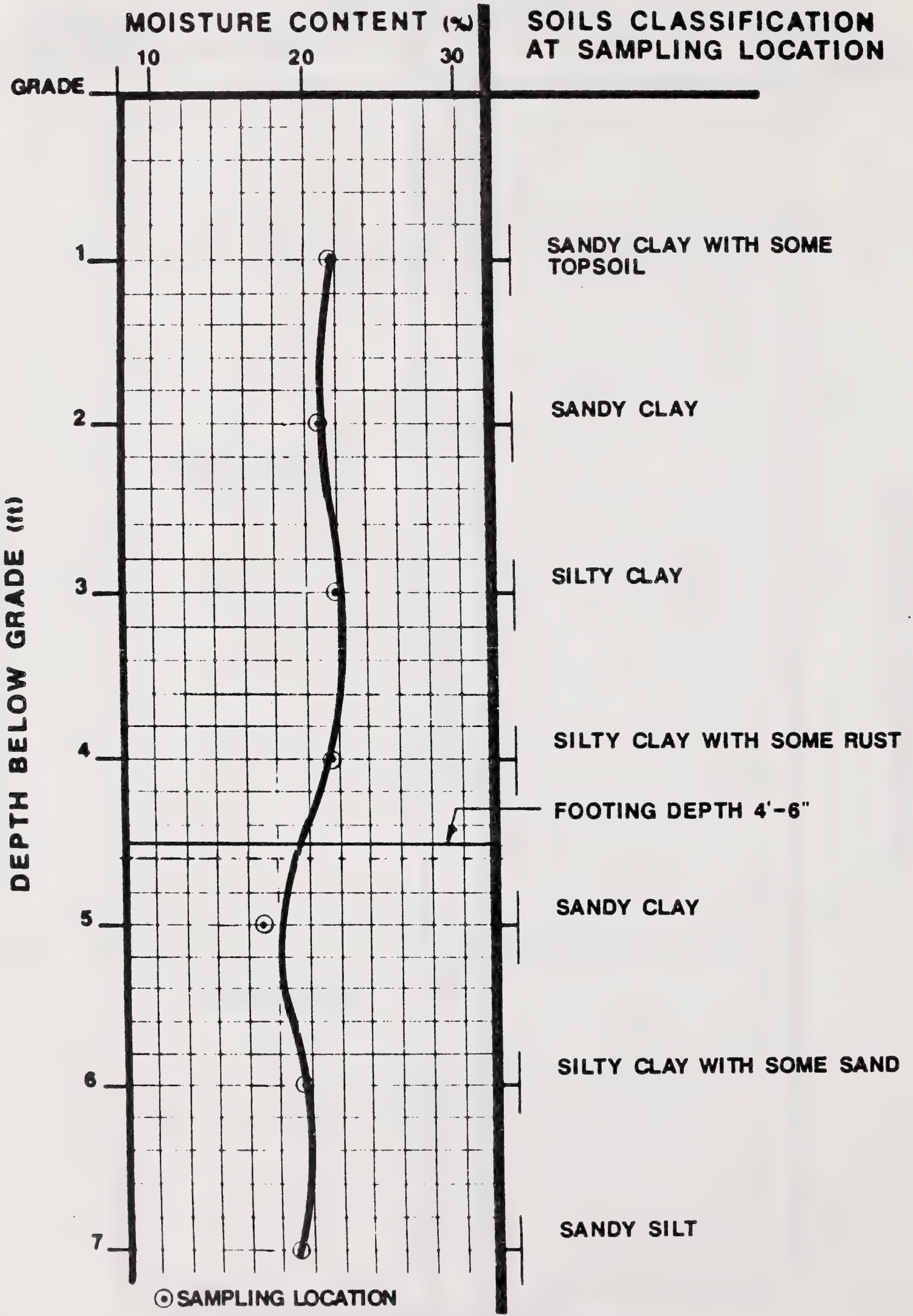
PWF STUDY #26
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



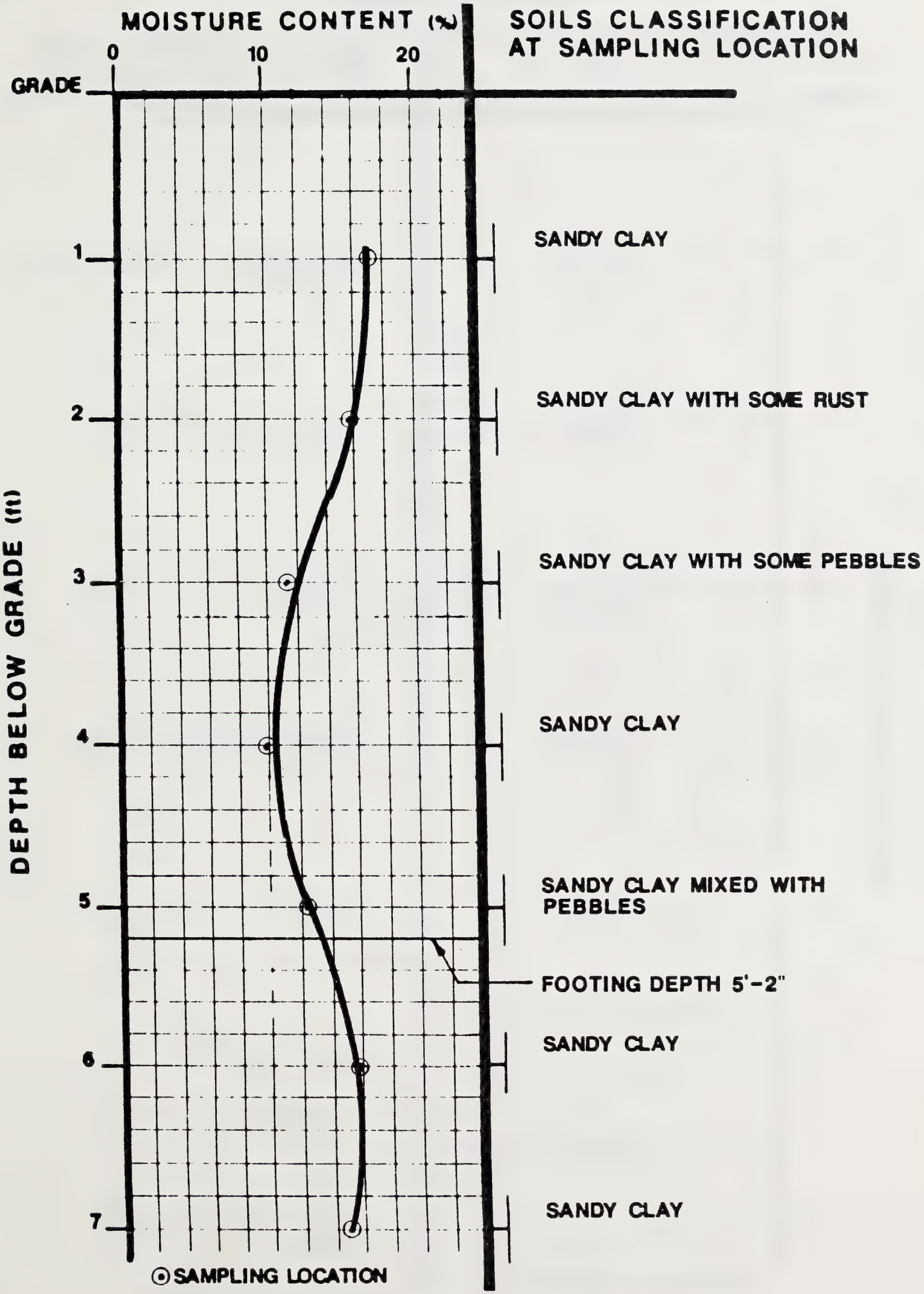
PWF STUDY #27
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



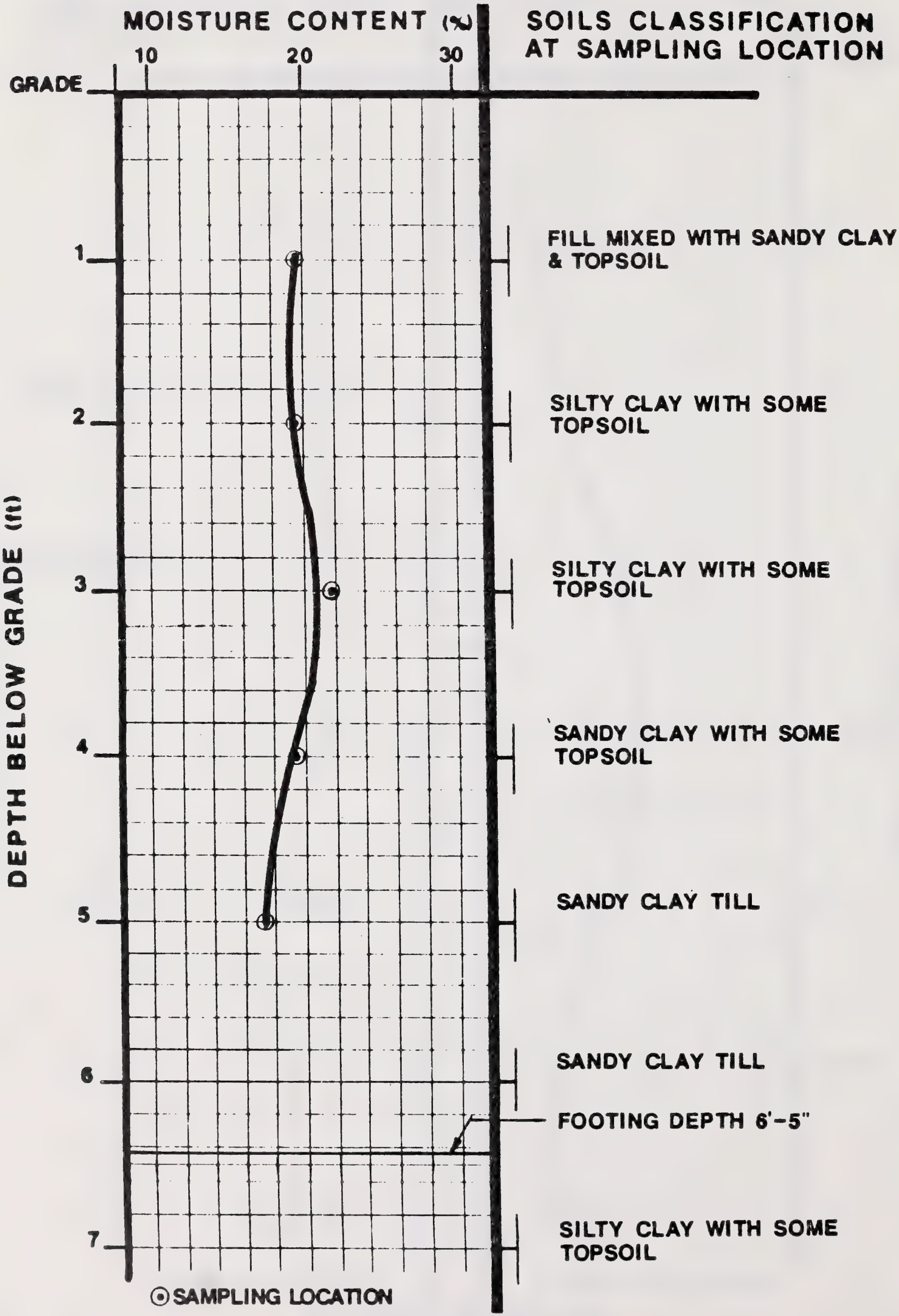
PWF STUDY #28
DRAINAGE IS NEGATIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



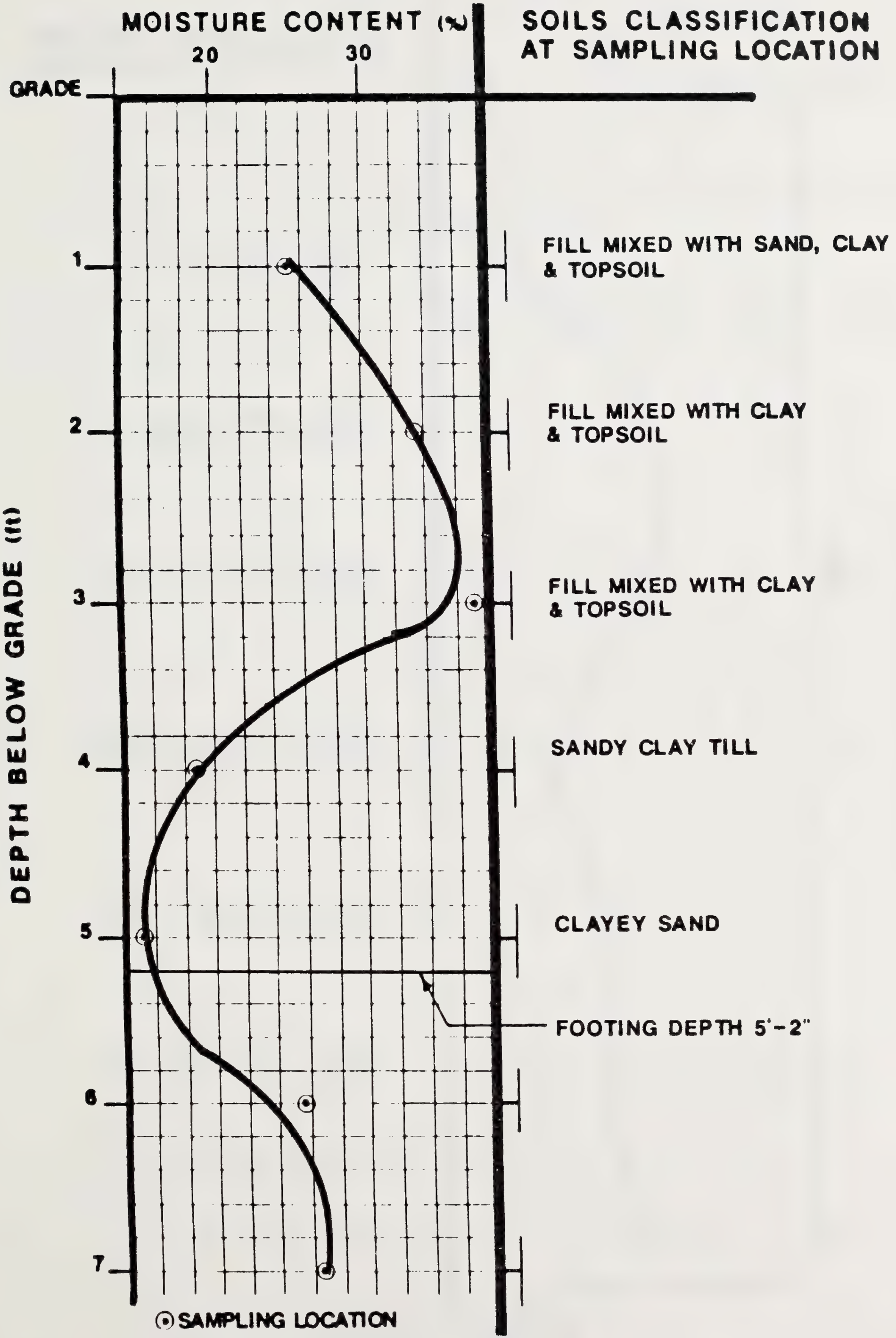
PWF STUDY #29
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



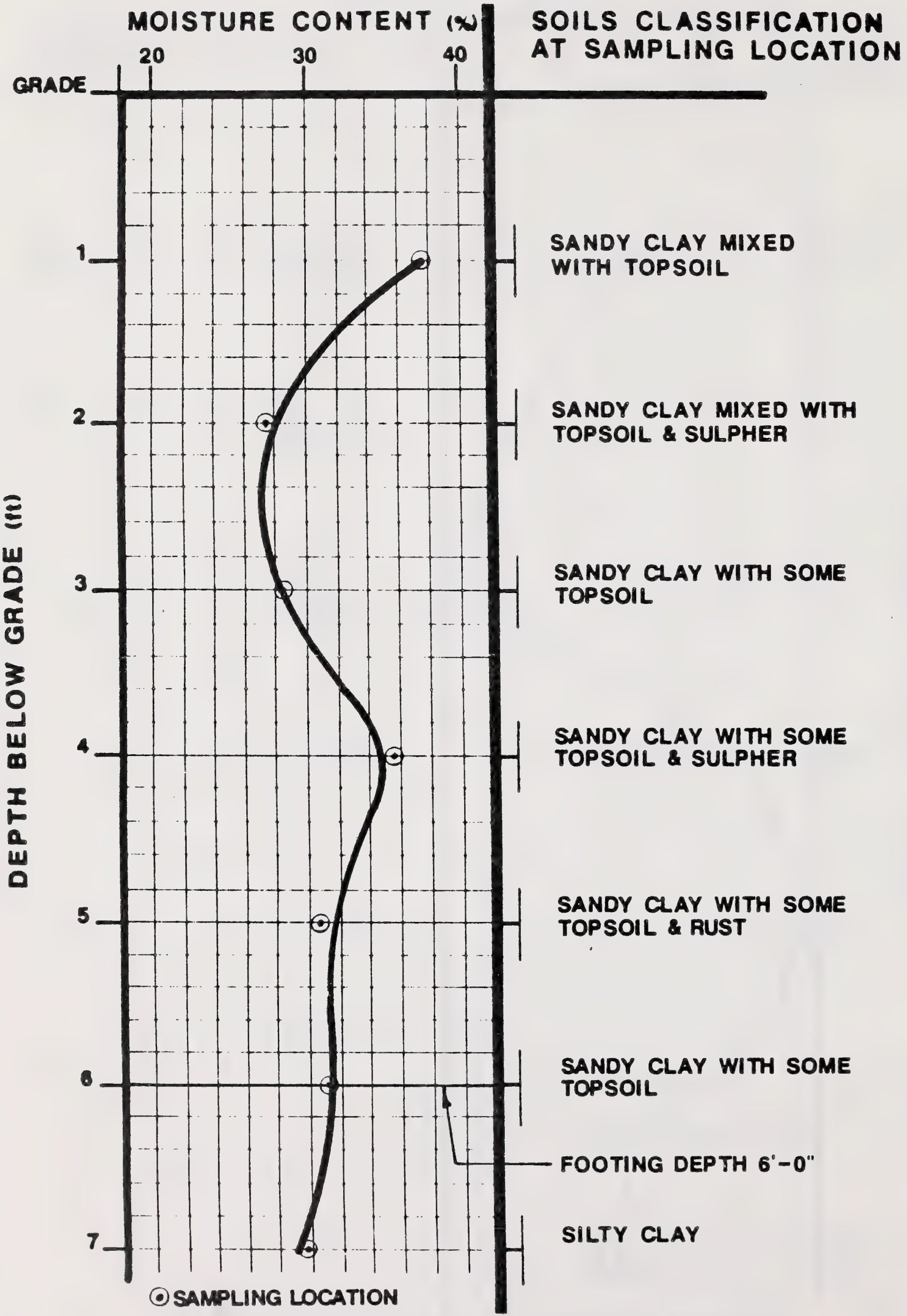
PWF STUDY #30
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
vs
DEPTH OF SOIL



PWF STUDY #31
DRAINAGE IS POSITIVE

MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
DEPTH OF SOIL



PWF STUDY #32
DRAINAGE IS POSITIVE

Appendix F Testing Standards, Design Standards and Engineering Calculations

This appendix contains listings of the Standards and Codes that were used in this Study and design parameters that were used for Engineering calculations and results of the Engineering Calculations.

Appendix F Testing Standards, Design Standards and Engineering Calculations

Part I Design Standards

This part contains a list of the applicable design standards and codes that were used in this Study.

Design Standards

1. National Building Code 1985.
2. National Building Code 1980.
3. Alberta Building Code 1985.
4. Alberta Building Code 1980.
5. CAN3-086-M80 Code For Engineering Design in Wood.
6. CAN3-086.1-M84 Enginering Design in Wood (Working Stress Design)
7. CAN3-086-M84 Engineering Design in Wood (Limit States Design)

8. CAN3-S406-M83 CONSTRUCTION OF PRESERVED WOOD FOUNDATIONS.

Appendix F Testing Standards, Design Standards. and Engineering Calculations

Part II Testing Standards

The standards that were used for measuring moisture contents in the wood and the soil are listed on page F5.

TESTING STANDARDS

1. ASTM D 2216-80 Standard Method for Laboratory Determination of water (moisture) content of the Soil, Rock and Soil-Aggregate Mixtures.

2. ASTM D 2016-74 (Reapproved 1984) Standard Test Methods for Moisture Content of Wood.

Appendix F Testing Standards, Design Standards and Engineering Calculations

Part III Design Parameters Used for Engineering Calculations in This Report.

The design parameters and the source of the design parameters are given on page F7 to F10.

DESIGN ASSUMPTIONS AND VALUES

	CAN3 - S406 M83	CAN3 - 086 M80	CAN3 - 086 M84	CAN3 - 086.1 M84	VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT
1.0 SOIL BEARING CAPACITY	1562 PSF	1562 PSF	1562 PSF	156S PSF	1562 PSF
2.0 CLEAR SPANS FOR FLOORS	16'-0"	16'-0"	16'-0"	16'-0"	16'-0"
3.0 FLOOR LOADINGS (LIVE LOAD)					
.1 FIRST FLOOR AND SUSPENDED FLOOR	39.6 PSF	39.6 PSF	39.6 PSF	39.6 PSF	39.6 PSF
.2 SECOND STOREY FLOOR	29.2 PSF	29.2 PSF	29.2 PSF	29.2 PSF	29.2 PSF
.3 REDUCTION FACTOR	0.8	0.8	0.8	0.8	0.8
4.0 FOUNDATION WALL HEIGHTS					
.1 SLAB FLOOR FOUNDATION	7'-10 1/2"	8'-0"	8'-0"	8'-0"	8'-0"
.2 SUSPEND WOOD FLOOR FOUNDATION	9'-10"	9'-10"	9'-10"	9'-10"	9'-10"
5.0 TOP OF GRANULAR LAYER TO TOP OF SUSPENDED FLOOR	1'-11 5/8"	2'-0"	2'-0"	2'-0"	2'-0"
6.0 LATERAL LOAD FROM SOIL PRESSURE: EQUIVALENT TO FLUID PRESSURE OF ____________.					
.1 GRANULAR BACKFILL	29.8 PCF	29.8 PCF	29.8 PCF	29.8 PCF	29.8 PCF
.2 STIFF CLAY BACKFILL	N/A	44.5 PCF	44.5 PCF	44.5 PCF	44.5 PCF
.3 SOFT CLAY BACKFILL	N/A	99.7 PCF	99.7 PCF	99.7 PCF	99.7 PCF
.4 MED CLAY BACKFILL	N/A	N/A	75.0 PCF	75.0 PCF	75.0 PCF
7.0 GROUND SNOW LOAD	62.5 PSF	62.5 PSF	62.5 PSF	62.5 PSF	62.5 PSF
8.0 BASIC SNOW LOAD COEFFICIENT	0.6	0.6	0.6	0.6	0.6
9.0 BASIC LIVE LOAD REDUCTION FACTOR (ROOF)	0.8	0.8	0.8	0.8	0.8

DESIGN ASSUMPTIONS AND VALUES

	CAN3 - S406 M83	CAN3 - 086 M80	CAN3 - 086 M84	CAN3 - 086.1 M84	VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT
.0 DEAD LOADS					
.1 ROOF	10.4 PSF	10.4 PSF	10.4 PSF	10.4 PSF	10.4 PSF
.2 FLOOR	9.8 PSF	10.4 PSF	10.4 PSF	10.4 PSF	9.8 PSF
.3 WALL (WITH SIDING)	6.7 PSF	6.7 PSF	6.7 PSF	6.7 PSF	6.7 PSF
.4 WALL (WITH MASONRY VENEER)	40.4 PSF	40.4 PSF	40.4 PSF	40.4 PSF	40.4 PSF
.5 FOUNDATION WALL	5.6 PSF	5.6 PSF	5.6 PSF	5.6 PSF	5.6 PSF
.6 PARTITIONS	4.2 PSF	4.2 PSF	4.2 PSF	4.2 PSF	4.2 PSF
.0 MODIFICATION FACTORS					
.1 LOAD DURATION (Kd)	0.9	0.9	0.9	0.9	0.9
.2 SIZE FACTOR (Kz)	N/A N/A	N/A N/A	2*6=1.3 2*8=1.2	2*6=1.3 2*8=1.2	2*6=1.3 2*8=1.2
.3 TREATMENT (Kt)	1.0	1.0	1.0	1.0	1.0
.4 LOAD - SHARING (Kh)					
BENDING	1.15	1.15	1.15	1.15	1.15
SHEAR	1.15	1.15	1.15	1.15	1.15
COMPRESSION	1.10	1.10	1.10	1.10	1.10
.5 SERVICE CONDITIONS (Ks)					
BENDING	0.84	1.0	1.0	1.0	1.0
COMPRESSION	0.69	1.0	1.0	1.0	1.0
SHEAR	0.96	1.0	1.0	1.0	1.0
M.o.E	0.94	1.0	1.0	1.0	1.0
2.0 ROOF LOADS ARE CARRIED TO THE EXTERIOR WALLS.	YES	YES	YES	YES	YES

DESIGN ASSUMPTIONS AND VALUES

	CAN3 - S406 M83	CAN3 - 086 M80	CAN3 - 086 M84	CAN3 - 086.1 M84	VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT
13.0 SPECIFIED STRENGTHS (SPF)					
.1 BENDING					
SELECT STRUCTURAL (Fb)	1519 PSI	1519 PSI	1302 PSI	2735 PSI	2735 PSI
No. 1 (Fb)	1288 PSI	1288 PSI	940 PSI	1982 PSI	1982 PSI
No. 2 (Fb)	1056 PSI	1056 PSI	940 PSI	1982 PSI	1982 PSI
No. 3 (STUD) (Fb)	593 PSI	593 PSI	694 PSI	1461 PSI	1461 PSI
.2 LONGITUDINAL SHEAR (Fu)	67 PSI	67 PSI	67 PSI	159 PSI	159 PSI
.3 COMPRESSION-PARALLEL TO GRAIN					
SELECT STRUCTURAL (Fc)	1143 PSI	1143 PSI	998 PSI	1875 PSI	1895 PSI
No. 1 (Fc)	897 PSI	897 PSI	897 PSI	1707 PSI	1707 PSI
No. 2 (Fc)	709 PSI	709 PSI	752 PSI	1432 PSI	1432 PSI
No. 3 (STUD) (Fc)	434 PSI	434 PSI	449 PSI	854 PSI	854 PSI
.4 COMPRESSION-PERPENDICULAR TO GRAIN (Fcn)	241 PSI	241 PSI	241 PSI	463 PSI	463 PSI
.5 MODULUS OF ELASTICITY					
SELECT STRUCTURAL (E)	1346 KSI	1346 KSI	1606 KSI	1606 KSI	1606 KSI
No. 1 (E)	1346 KSI	1346 KSI	1476 KSI	1476 KSI	1476 KSI
No. 2 (E)	1215 KSI	1215 KSI	1476 KSI	1476 KSI	1476 KSI
No. 3 (STUD) (E)	1085 KSI	1085 KSI	1403 KSI	1403 KSI	1403 KSI
14.0 RESISTANCE FACTORS					
.1 BENDING MOMENT (Mr)	N/A	N/A	N/A	0=0.7	0=0.7
.2 COMPRESSION (Pr)	N/A	N/A	N/A	0=0.75	0=0.75

DESIGN ASSUMPTIONS AND VALUES

	CAN3 - S406 M83	CAN3 - 086 M80	CAN3 - 086 M84	CAN3 - 086.1 M84	Value Recommended By This Report
5.0 LOAD FACTORS					
.1 DEAD LOAD (d)	N/A	N/A	N/A	=1.25	=1.25
.2 LIVE LOAD (l)	N/A	N/A	N/A	=1.50	=1.50
6.0 FACTORS FOR INDIVIDUAL SPECIES					
.1 BENDING					
JACKPINE	N/A	1.27	N/A	N/A	N/A
LODGEPOLE PINE	N/A	1.14	N/A	N/A	N/A
WHITE SPRUCE	N/A	1.00	N/A	N/A	N/A
.2 COMPRESSION-PARALLEL TO GRAIN					
JACKPINE	N/A	1.18	N/A	N/A	N/A
LODGEPOLE PINE	N/A	1.15	N/A	N/A	N/A
WHITE SPRUCE	N/A	1.00	N/A	N/A	N/A
.3 MODULUS OF ELASTICITY					
JACKPINE	N/A	1.04	N/A	N/A	N/A
LODGEPOLE PINE	N/A	1.12	N/A	N/A	N/A
WHITE SPRUCE	N/A	1.02	N/A	N/A	N/A

Appendix F Testing Standards, Design Standards, and Engineering Calculations

Part IV Maximum Backfill Heights

The table on page F12 contains the results of the calculations for maximum backfill heights.

MAXIMUM BACKFILL HEIGHTS

CRITERI

- -STUD TYPE = S-P-F UNLESS SHOWN OTHERWISE
- -STUD HEIGHT = 8'-0"
- -MAXIMUM BUILDING WIDTH PARALLEL TO JOISTS IS 32'-9 3/4"
- -DESIGN LOADS AS PER CAN3-S406-M83
- -ALLOWABLE STRESSES AND FACTORS AS PER GIVEN DESIGN STANDARD
- -DRY SERVICE CONDITIONS ASSUMED FOR ALL STANDARDS (EXCEPT GIVEN HEIGHTS IN CAN3-S406-M83 ARE BASED ON WET SERVICE CONDITIONS)

MAXIMUM BACKFILL HEIGHTS

S-P-F MATERIAL

STUD SIZE	STUD SPACING	GRADE	CAN3 S406 M83	CAN3-086-M80 S-P-F WHITE SPRUCE	CAN3-086-M80 S-P-F LODGEPOLE PINE	CAN3-086-M80 JACK PINE	CAN3-086-M84 S-P-F	CAN3 086.1 M84 S-P-F
2 * 6	16"o.c.	SELECT STRUCTURAL	5'-3"	5'-8"	6'-1"	6'-4"	6'-5"	7'-2"
		#1	4'-7"	5'-3"	5'-8"	5'-11"	5'-6"	6'-3"
		#2	4'-7"	4'-8"	5'-1"	5'-3"	5'-4"	6'-1"
		#3 STUD *	N/A	3'-5"	3'-9"	3'-11"	4'-3"	4'-11"
2 * 6	12"o.c.	SELECT STRUCTURAL	6'-3"	6'-7"	7'-2"	7'-6"	7'-8"	8'-4"
		#1	5'-7"	6'-2"	6'-7"	6'-11"	6'-6"	7'-0"
		#2	5'-7"	5'-6"	5'-11"	6'-2"	6'-4"	6'-10"
		#3 STUD *	N/A	4'-1"	4'-5"	4'-8"	5'-2"	5'-7"
2 * 8	16"o.c.	SELECT STRUCTURAL	6'-7"	7'-7"	8'-3"	8'-9"	8'-6"	9'-8"
		#1	6'-3"	7'-0"	7'-7"	8'-0"	7'-0"	8'-0"
		#2	6'-3"	6'-2"	6'-8"	7'-1"	7'-0"	7'-10"
		#3 STUD *	N/A	4'-7"	4'-11"	5'-10"	5'-7"	6'-5"
2 * 8	12"o.c.	SELECT STRUCTURAL	NOT GIVEN	9'-1"	10'-0"	10'-9"	10'-5"	12'-2"
		#1	NOT GIVEN	8'-4"	9'-0"	9'-8"	8'-6"	9'-4"
		#2	NOT GIVEN	7'-4"	7'-11"	8'-5"	8'-4"	9'-2"
		#3 STUD *	N/A	5'-5"	5'-10"	6'-1"	6'-9"	7'-4"

Appendix F Testing Standards, Design Standards and Engineering Calculations

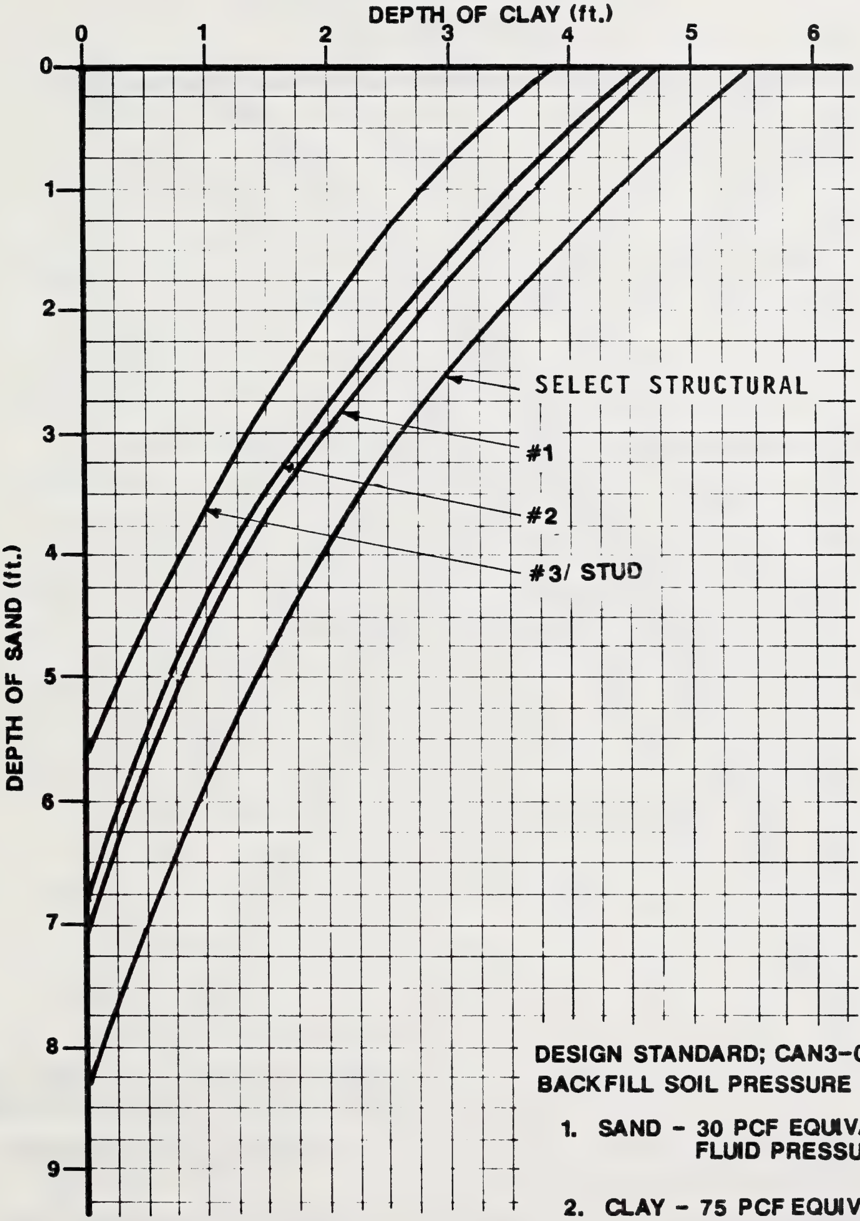
Part V Combined Backfill Charts

The charts on pages F13 to F16 contain plots of Clay depth vs Sand depth and curves of equal deflection or equal bending moment.

THE TABLES IN THIS SECTION ARE NOT TO BE USED FOR DESIGN PURPOSES. A REVISED CAN3-086 IS CURRENTLY BEING PUBLISHED AND THE CURVES WILL CHANGE.

COMBINED BACKFILL
CLAY OVER SAND

2"x6" S-P-F @ 12" o.c.



DESIGN STANDARD; CAN3-086.1-M84

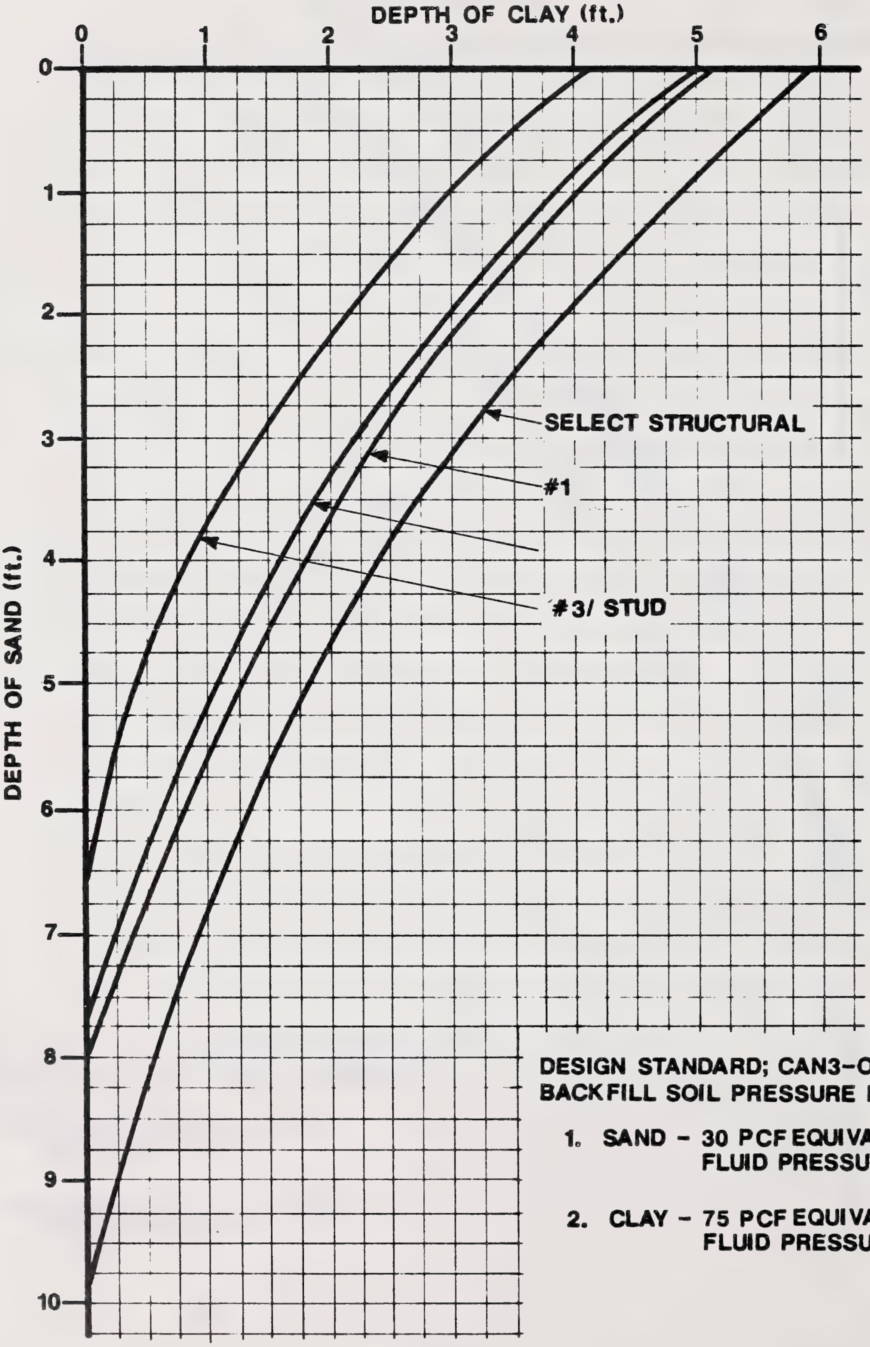
BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE

2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

COMBINED BACKFILL
CLAY OVER SAND

2"x8" S-P-F @ 16" o.c.

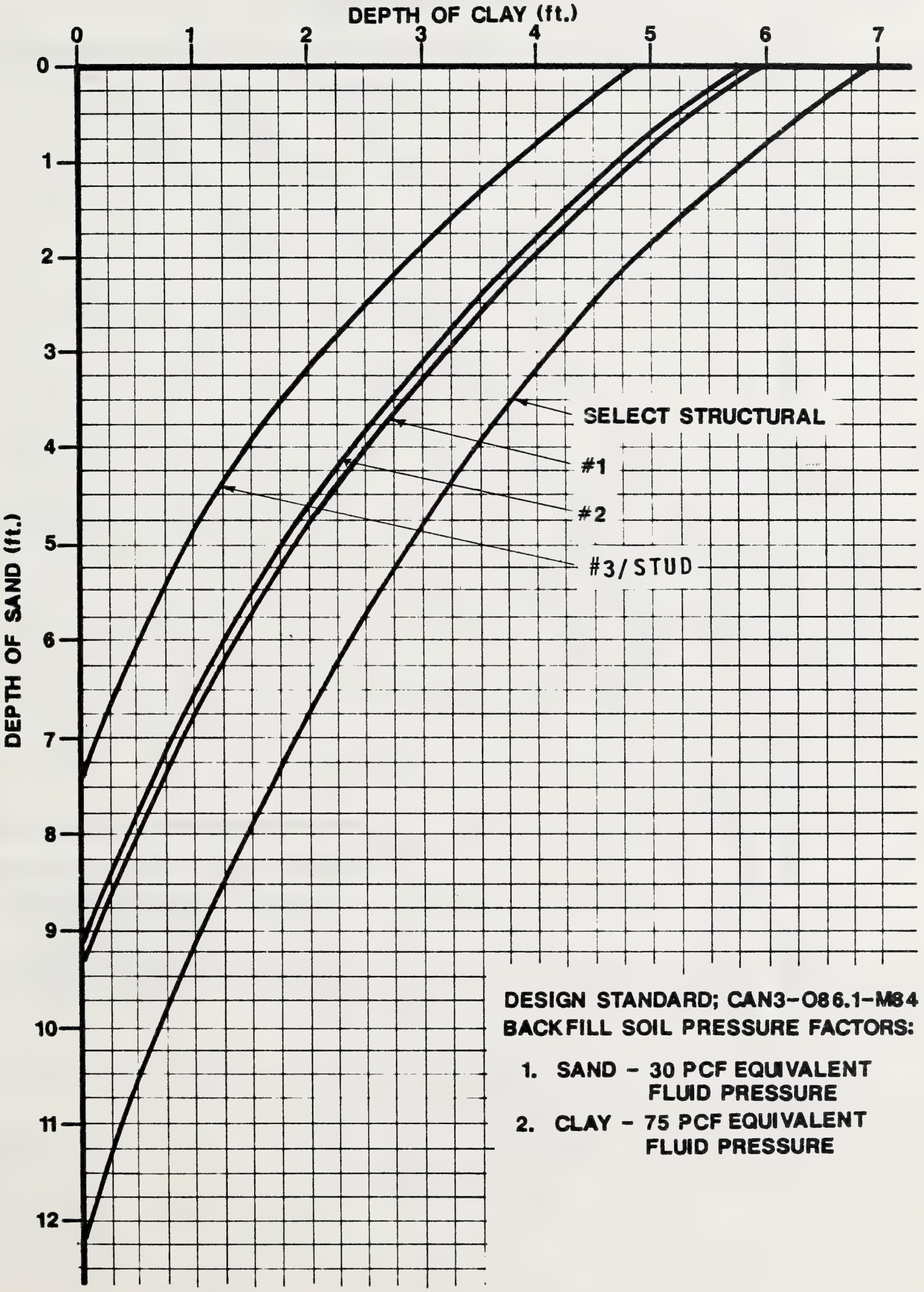


DESIGN STANDARD; CAN3-O86.1-M84
BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE

2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

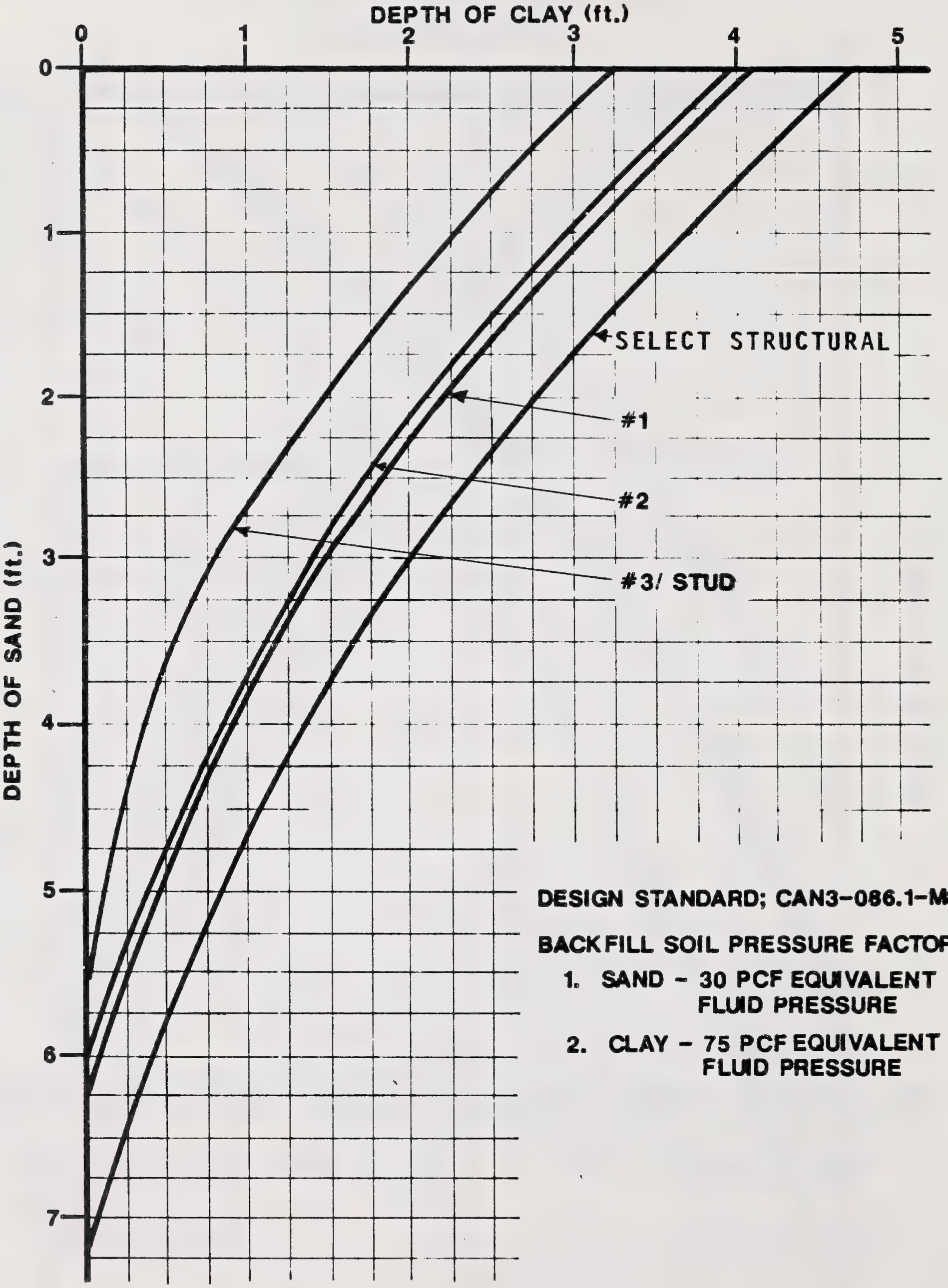
COMBINED BACKFILL
CLAY OVER SAND
2"x8" S-P-F @ 12" o.c.



DESIGN STANDARD; CAN3-O86.1-M84
BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE
2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

COMBINED BACKFILL
CLAY OVER SAND
2"x6" S-P-F @ 16" o.c.



DESIGN STANDARD; CAN3-086.1-M84

BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE
2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

Appendix G Glossary of Terms

ACA	-	is the trade or industrial abbreviation for Ammonical Copper Arsenate, one of the two chemicals approved for treating PWF material.
Base Plate	-	it is the plate or the 2" dimensional lumber at the bottom of the studs in the wall.
Cap Plate	-	it is the plate or the 2" dimensional lumber directly on top of the top plate.
CCA	-	is the trade or industry abbreviation for Chromated Copper Arsenate, one of the two chemicals approved for treating PWF material.
Combined Drainage	-	this includes both negative and positive drainage situations.
Drainage Rock Layer	-	this is a layer of rock that is placed below the floor of the basement.
Equivalent Fluid Pressure	-	the backfill material places pressure on the wall, when this pressure is equated to a fluid pressure the resulting number is the equivalent fluid pressure.
Exterior Stud	-	it is a PWF stud in the exterior wall of the foundation.
Footing Plate	-	it is the plate or the 2" dimensional lumber below or under the base plate.
Grade	-	it is the level of the backfill on the exterior of the PWF wall.
L/180 deflection	-	the deflection is the length divided by 180.
Moisture Content	-	is the ratio of the weight of the water or moisture in the wood divided by the dry weight of the wood.
Negative Drainage	-	this occurs when the backfill is horizontal or it slopes towards the house.
Permeability	-	the ease with which water can pass through a material.

Positive Drainage - this occurs when the backfill slopes away from the house.

PWF - preserved wood foundation.

S-P-F - this is a categorey of woods that includes Spruce, Pine and Fir species.

Top Plate - it is the plate or the 2" dimensional lumber directly on top of the wall stud.

N.L.C. - B.N.C.
3 3286 09008034 8